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Trends in Energy Consumption and Energy Efficiency 2000 – 2012

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Abstract

This report aims at showing the present status of energy consumption in EU-28, in the four main energy consuming sectors: Residential, tertiary, transport and industry. During the last years, there have been efforts by the European Union to cut down on energy consumption and improve energy efficiency. From 2000-2012, there have been various initiatives that aim at reducing final energy consumption. Therefore the report demonstrates the energy consumption progress from 2000-2012 in the four sectors. Besides the final energy consumption, electricity and gas consumption are analysed, as they are the most important alternatives to oil. The report consists of five chapters. The first chapter compares data for gross and final energy consumption. This comparison gives insights about energy consumption/losses that take place before the delivery of energy for the final end use. Chapter 2 analyses the final energy consumption in the residential sector. A special focus is given in this sector, because many policies have been implemented here. The analysis includes consumption drivers such as economic growth, population, heating demand, household characteristics and energy prices. Chapter 3 focuses on the tertiary sector and gives an overview of the energy consumption changes. Chapter 4 analyses the transport sector with a focus on the road sector. Last, chapter 5 gives an overview of the main changes in the industry sector in the energy consumption and production output.

TRENDS IN ENERGY CONSUMPTION AND ENERGY EFFCIENCY 2000 - 2012

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Introduction

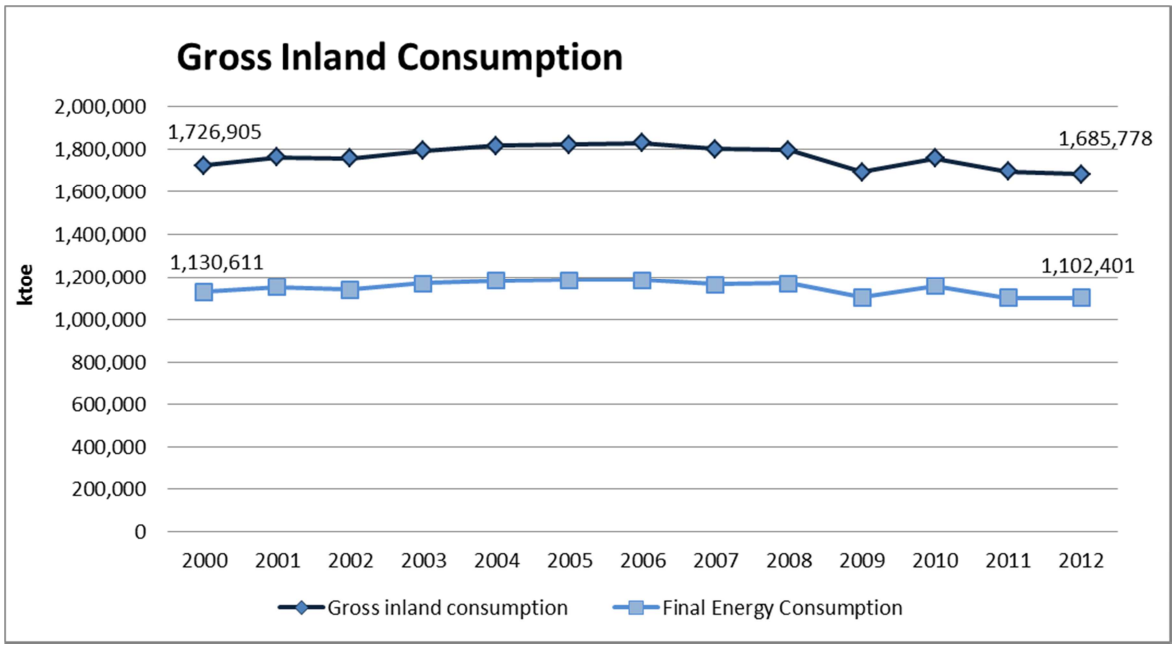
This report aims at showing the present status of energy consumption in EU-28, in the four main energy consuming sectors: Residential, tertiary, transport and industry. During the last years, there have been efforts by the European Union to cut down on energy consumption and improve energy efficiency. From 2000-2012, there have been various initiatives that aim at reducing final energy consumption. Therefore the report demonstrates the energy consumption progress from 2000-2012 in the four sectors. Besides the final energy consumption, electricity and gas consumption are analysed, as they are the most important alternatives to oil. The report consists of five chapters. The first chapter compares data for gross and final energy consumption. This comparison gives insights about energy consumption/losses that take place before the delivery of energy for the final end use. Chapter 2 analyses the final energy consumption in the residential sector. A special focus is given in this sector, because many policies have been implemented here. The analysis includes consumption drivers such as economic growth, population, heating demand, household characteristics and energy prices. Chapter 3 focuses on the tertiary sector and gives an overview of the energy consumption changes. Chapter 4 analyses the transport sector with a focus on the road sector. Last, chapter 5 gives an overview of the main changes in the industry sector in the energy consumption and production output.

1. Gross and Final Energy Consumption

Gross inland consumption is the energy available for final consumption plus the energy that was consumed in the stages before the delivery to the final destination. Final energy consumption is the amount of energy that is actually consumed in the different subsectors. In this report the main focus will be on the final energy consumption, however gross inland consumption is also important in order to have an indication of the losses that happen before the delivery of the energy for the final consumption.

Gross inland consumption in EU-28 declined from 1,727 Mtoe in 2000 to 1,686 Mtoe in 2012. Fig. 1 shows how gross inland consumption and final energy consumption have evolved from 2000 onwards and it can be seen that both have declined. Final energy consumption is the 65.5% of the gross inland consumption. That means that a large share of 34.5% of energy is consumed in non-energy uses, which is important to mention, for understanding the efficiency of the entire energy system.

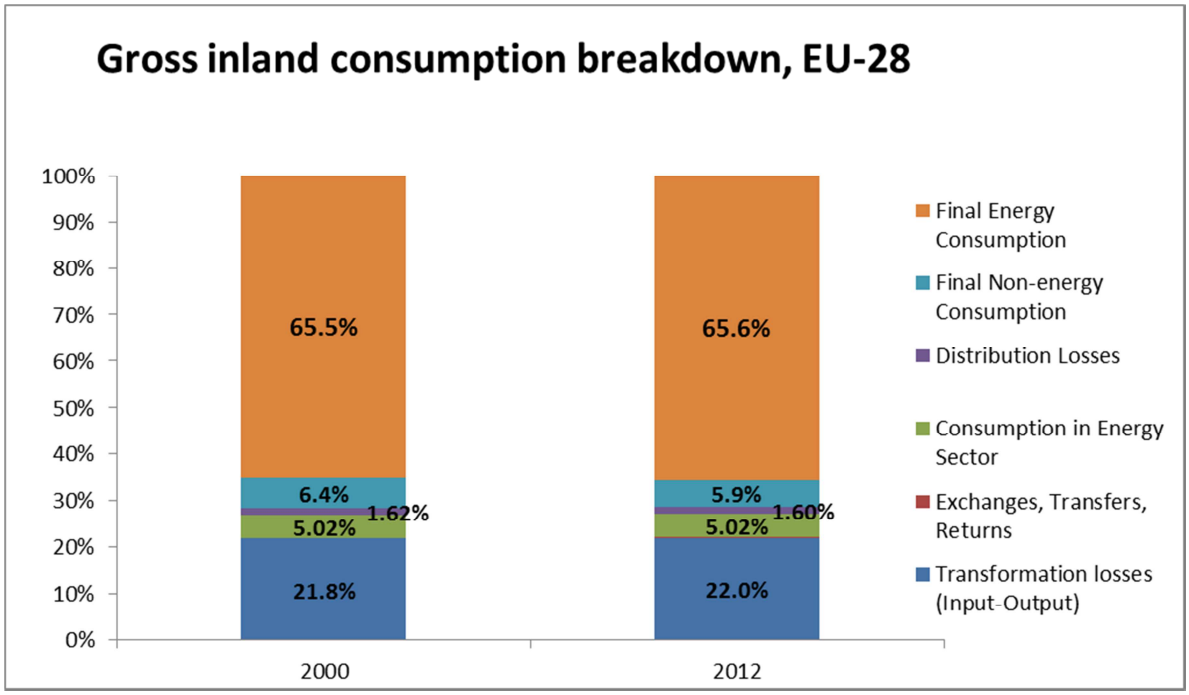
Fig. 1 Gross Inland energy consumption – Final energy consumption, EU-28, Data Eurostat.



The difference between gross inland and final energy consumption, is due to transformation losses (22%), consumption in the energy sector (5%), final non energy consumption (5.9%), distribution losses (1.6%) and other exchanges, transfers, returns (0.03%) (

Fig. 2). Compared to 2000 there has been a 0.1% increase of the share of the final energy to gross inland consumption. This is the result of a reduction of the share of the distribution losses and the final non energy consumption but also of growth of the share of transformation losses. However these changes are very small and the main consumption patterns have remained the same.

Fig. 2 Gross Inland consumption into sub-sectors. EU-28 Data: Eurostat.



Final energy consumption in different sectors.

In 2012 final energy consumption in EU-28 for all sectors was 1,104 Mtoe (Table 1). This energy was consumed by four main sectors (Fig. 3). The sector with the largest share of final energy consumption is the transport sector, which consumed 31.8% of the final energy consumption in all sectors. The residential sector is second, consuming 26.2% of this energy. Industry is third with the consumption reaching 25.6% of the final consumption and last, the share of the service sector is 13.5%. Fig. 4 shows the energy consumption per sector for 2000 and 2012 and Fig. 5 shows how the energy consumption of each sector has changed in the time period 2000-2012. It shows how the energy consumption in the industry and residential sector can vary a lot in different years, while the energy consumption of the transport and energy sector changes more gradually.

Fig. 3 Final energy consumption – Shares by sector, EU-28, 2012, Data-Eurostat

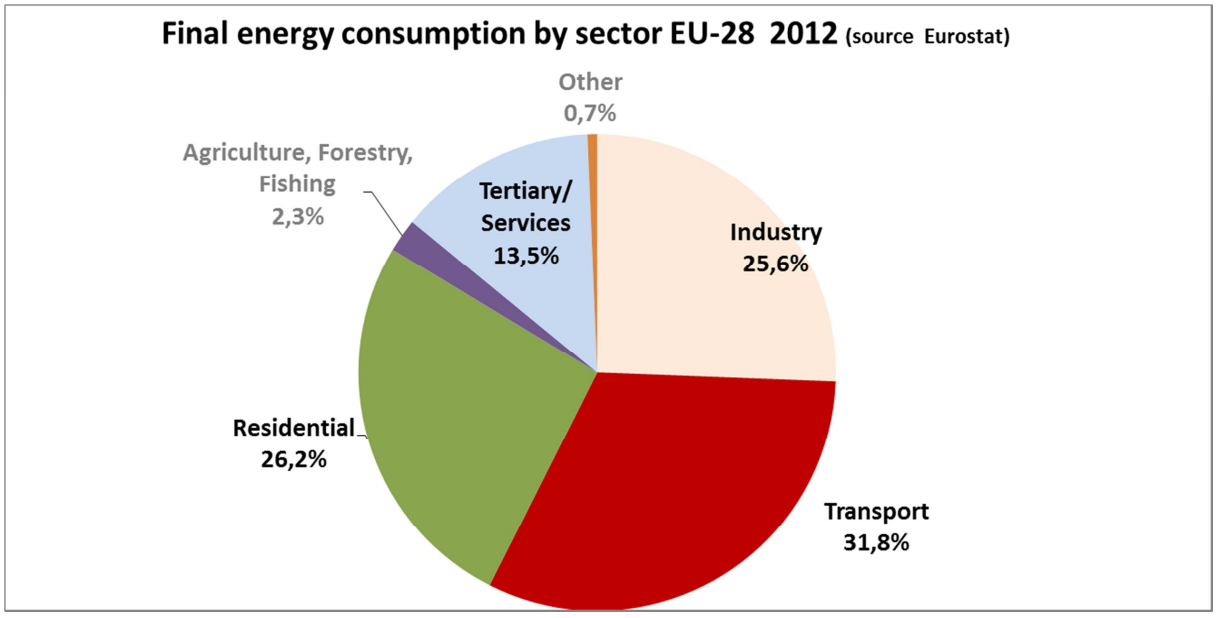


Fig. 4 Final energy consumption by sector in EU-28 for 2000,2012 Data: Eurostat.

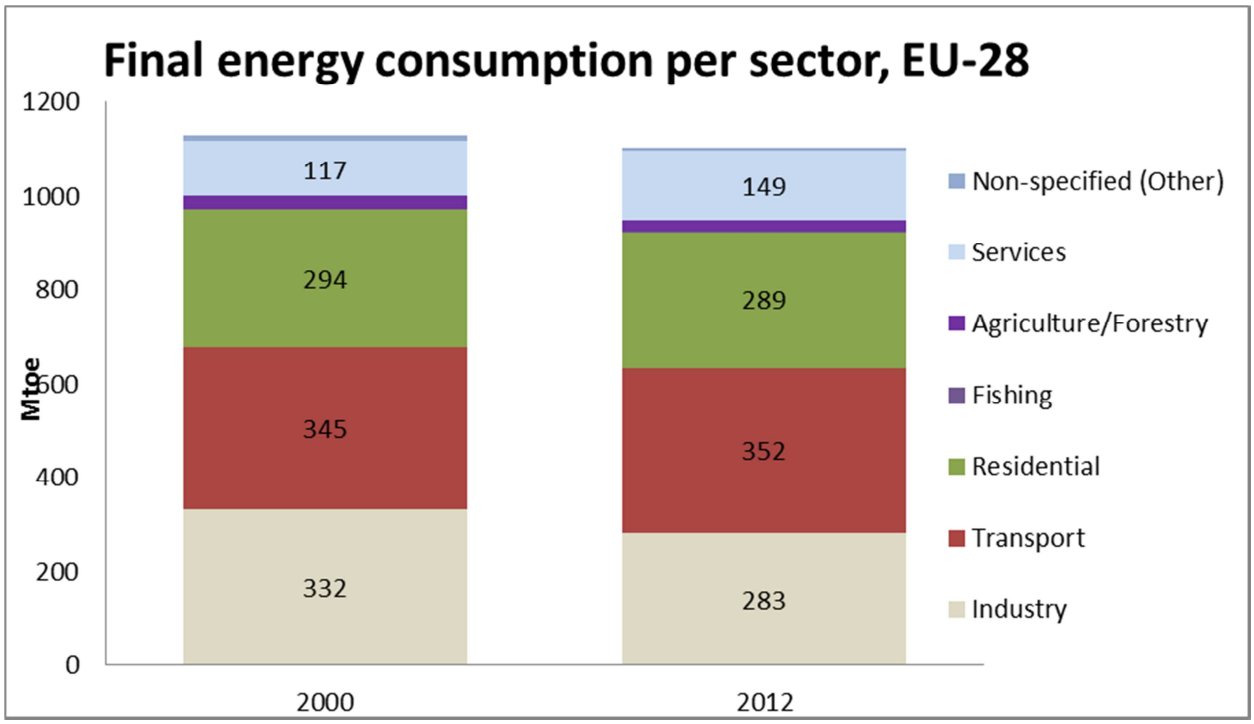


Fig. 5 Energy consumption dynamics through all the sectors, EU-28 Data: Eurostat.

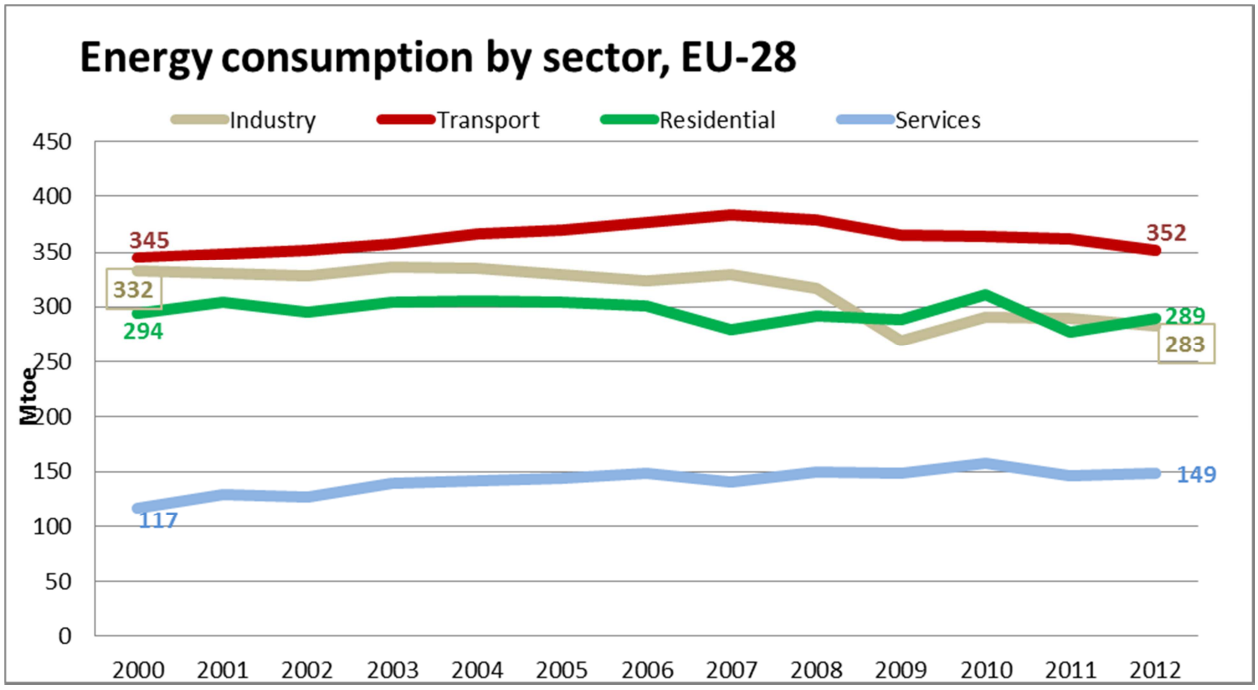
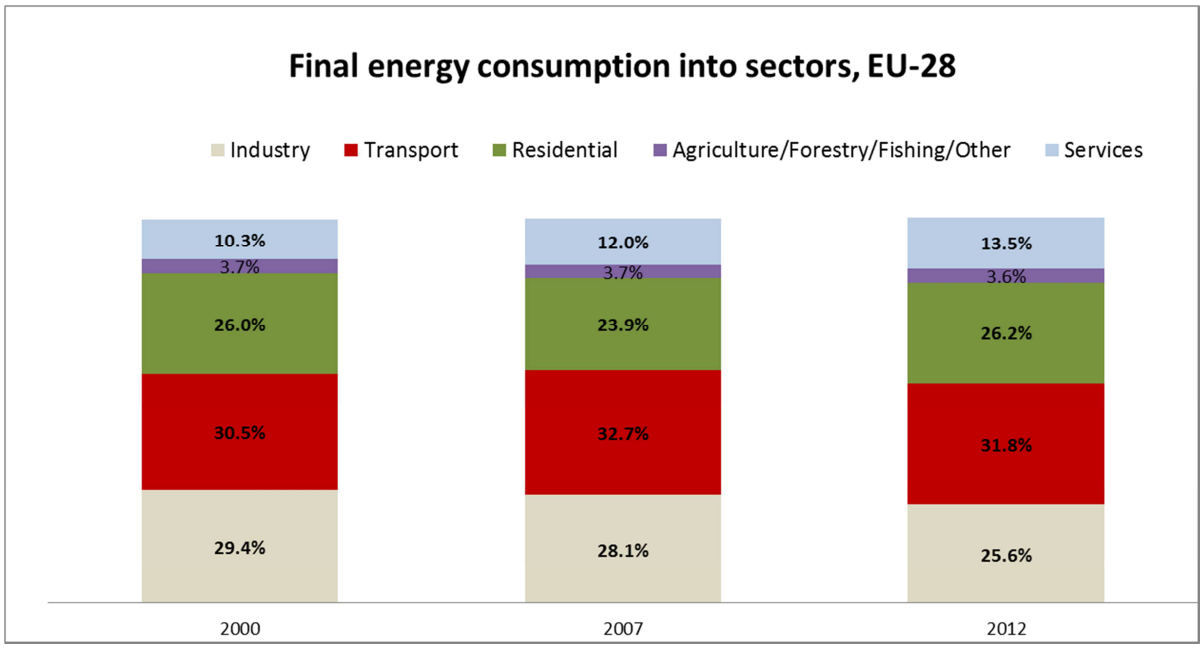


Fig. 6 Final energy consumption-Share of each sector to the final, EU-28, Data: Eurostat



Final energy consumption declined by 2.3% the period 2000 – 2012. In 2000 it was 1,131 Mtoe and this dropped to 1,104 Mtoe by 2012 (Table 1). The sub-sectors were there was reduction in final energy consumption compared to 2000 are the residential sector (-1,8%) and industry sector (-14.9%). On the contrary, energy consumption went up in the service sector by +27,2% and in the transport sector by +1,9%. Therefore the main changes in the share of each sector to the final consumption are a growth of the service sector by +3.2% (Fig. 6) and a decline of the industry sectors' share by -3.8%. The shares of the residential and transport sector over the total have changed less, by +0.2% and +1.3% respectively.

Table 1 Overview of energy consumption changes for different sub-sectors, EU-28 Data: Eurostat

	Energy consumption per sector, EU-28												
(Mtoe)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Final	1131	1154	1142	1174	1187	1189	1190	1170	1175	1108	1160	1108	1104
Industry	332	331	328	336	335	330	324	329	317	270	291	289	283
Residentia	294	304	295	304	305	305	301	279	291	289	311	278	289
Tertiary	117	129	127	139	141	144	148	141	150	149	157	147	149
Transport	345	348	351	357	366	370	377	383	378	365	364	362	352
	% Change from 2000												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Final		2,1%	1,0%	3,8%	4,9%	5,1%	5,2%	3,5%	3,9%	**-2,0%**	2,6%	**-2,0%**	**-2,3%**
Industry		-0,5%	**-1,4%**	1,1%	0,8%	**-0,8%**	**-2,5%**	**-1,1%**	**-4,5%**	**-18,8%**	**-12,5%**	**-12,9%**	**-14,9%**
Residential		3,2%	0,3%	3,2%	3,7%	3,5%	2,2%	**-5,1%**	**-1,0%**	**-1,9%**	5,7%	**-5,7%**	**-1,8%**
Tertiary		10,2%	8,3%	19,1%	21,0%	22,9%	26,6%	20,4%	27,9%	27,3%	34,6%	25,4%	27,2%
Transport		1,0%	1,8%	3,4%	6,2%	7,1%	9,3%	11,0%	9,6%	5,8%	5,4%	4,9%	1,9%
	% Annual change												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Final		2,1%	**-1,1%**	2,8%	1,1%	0,2%	0,1%	**-1,7%**	0,4%	**-5,7%**	4,7%	**-4,5%**	-0,3%
Industry		-0,5%	**-0,9%**	2,5%	-0,3%	**-1,6%**	**-1,7%**	1,5%	**-3,5%**	**-15,0%**	7,7%	-0,4%	**-2,3%**
Residential		3,2%	**-2,8%**	2,9%	0,5%	-0,3%	**-1,2%**	**-7,2%**	4,4%	**-0,8%**	7,7%	**-10,8%**	4,2%
Tertiary		10,2%	**-1,7%**	10,0%	1,6%	1,6%	3,0%	**-4,9%**	6,2%	-0,5%	5,7%	**-6,8%**	1,5%
Transport		1,0%	0,8%	1,6%	2,7%	0,9%	2,0%	1,6%	**-1,2%**	**-3,5%**	-0,4%	-0,5%	**-2,8%**

Final energy consumption dynamics

The decline of 2.3% in the final energy consumption, for the period 2000-2012, has not been gradual. Until 2012, final energy consumption was higher every year compared to 2000, with the exception of the years 2009, 2011 and 2012. From 2003 until 2006 there was a constant growth (Fig. 7). The years 2002 and 2007, although final energy consumption was still more than that of 2000, the annual rate of growth was lower, which could be related to the high temperature of these years (see

Fig. 43). Consumption reached a peak on 2006 with 5.2% growth and a minimum on 2012 with a drop of 2.3%, compared to 2000 levels.

Fig. 7 Final energy consumption in EU 2000-2012, Data: Eurostat

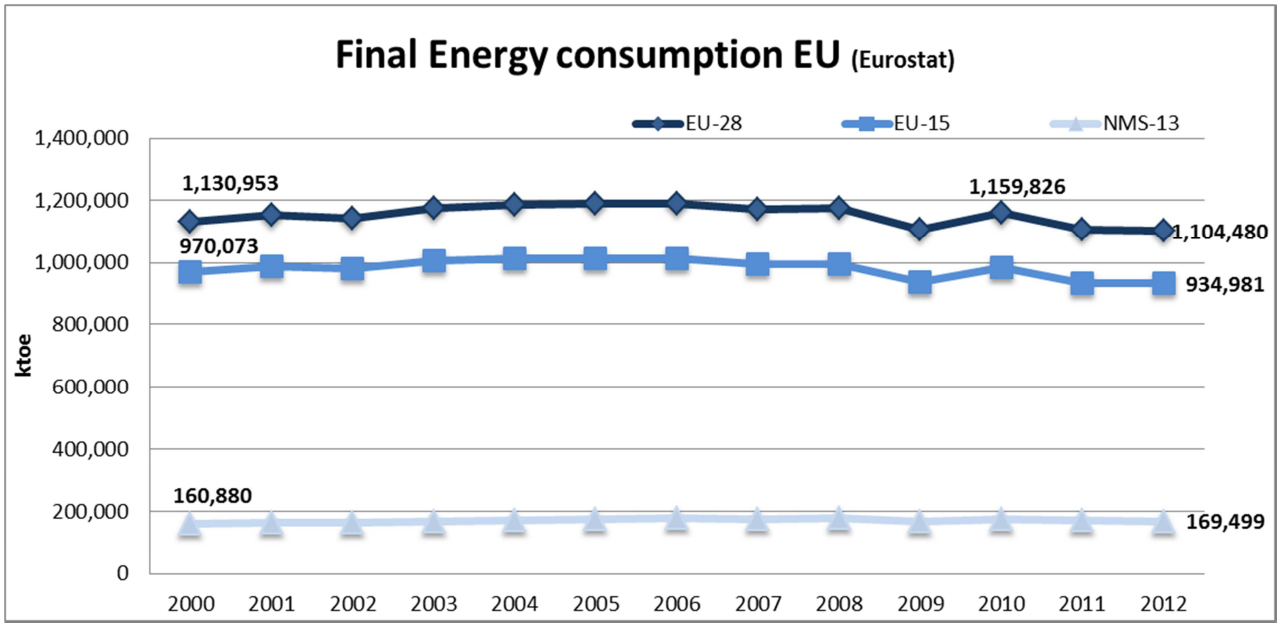
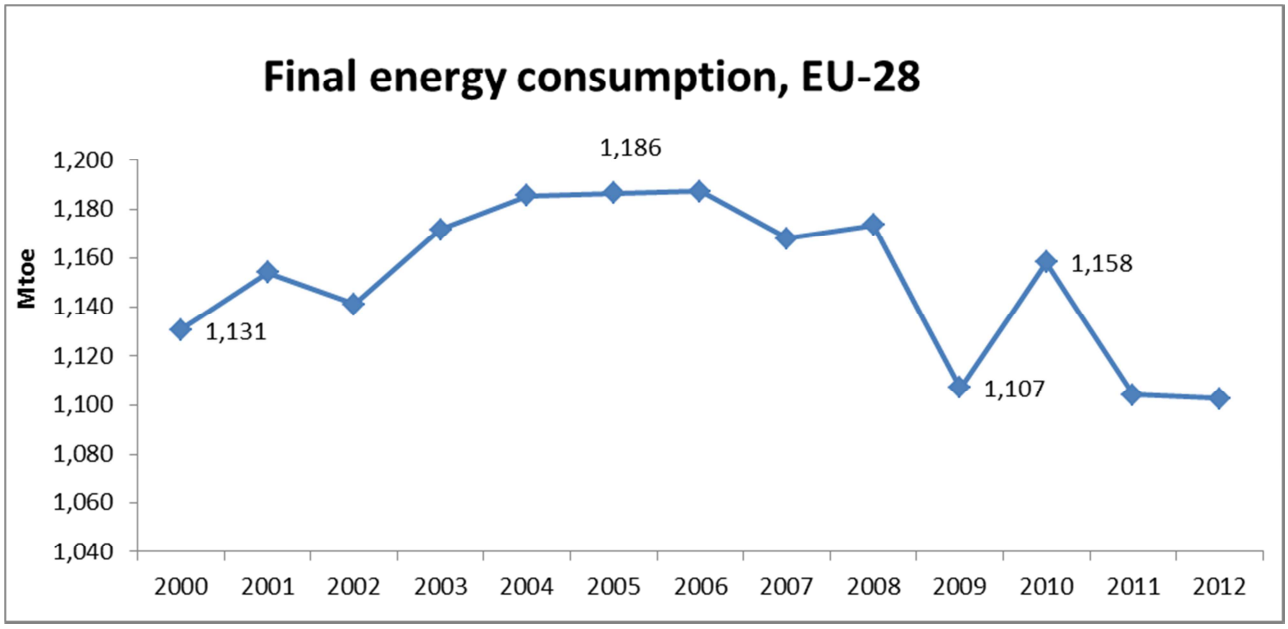


Fig. 8 Final Energy consumption, EU-28, Data: Eurostat



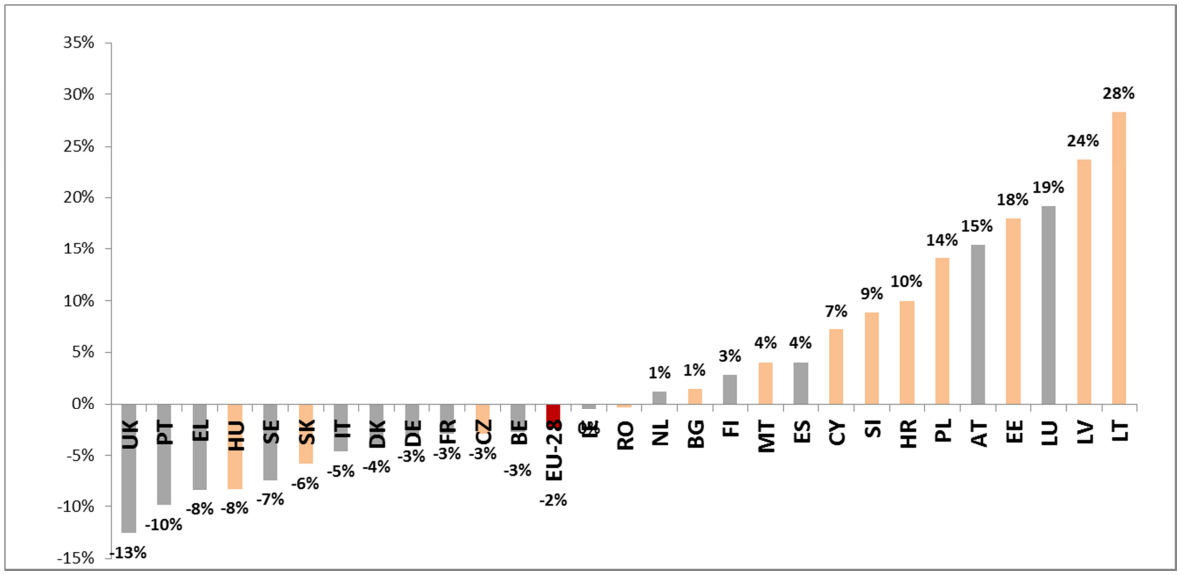
From the 1,104 Mtoe of final energy consumption in EU-28, 85% (935 Mtoe) was consumed in EU-15 and 15% (169 Mtoe) in NMS-13 (Table 2). Only in EU-15 did the final energy consumption dropped below the 2000 levels. In NMS-13 final energy consumption is constantly higher above the energy consumption of 2000. In EU-15 final energy consumption dropped from 970 Mtoe in 2000 to 935 Mtoe in 2012. This represents a reduction of 3.6%. Final energy consumption in EU-15 reached a peak on 2005 with 1,015 Mtoe which is 4.6% higher than the consumption in 2000. The minimum consumption for this period was in 2012 with a 3.6% decline. As in EU-28, the only years when the consumption was less compared to 2000, was in 2009, 2011 and 2012. Between the years 2003-2006 there was a constant growth. The years 2002 and 2007 there was a drop in the rate of growth but consumption was still higher than that of 2010.In NMS-13 final consumption grew from 161 Mtoe in 2000 to 169 Mtoe in 2012. This equals a growth of 5.4%. Besides the energy consumption being always higher than that of 2000, there was reduction in the growth rate for the years 2002,2007,2007,2011 and 2012. The peak point was in 2008 with 178 Mtoe consumed, a 10.5% increase compared to 2000. After 2010 the growth rate dropped, in 2012 the number was 5.4% higher than the 2000 levels, which was similar to 2003 and 2009 numbers.

Table 2 Final Energy Consumption – Growth rates in EU-28, EU-15, NMS-13, Data: Eurostat

Final Energy Consumption ktoe													
(ktoe)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	1130953	1154409	1142226	1173678	1186570	1188508	1190094	1170359	1174571	1107845	1159826	1107982	1104480
EU-15	970073	989940	979435	1005040	1014445	1014560	1012439	993721	996786	939551	982946	935656	934981
NMS-13	160880	164470	162791	168638	172126	173949	177655	176638	177786	168294	176880	172326	169499
% Change from 2000													
% EU 28		2.1%	1.0%	3.8%	4.9%	5.1%	5.2%	3.5%	3.9%	**-2.0%**	2.6%	**-2.0%**	**-2.3%**
% EU 15		2.0%	1.0%	3.6%	4.6%	4.6%	4.4%	2.4%	2.8%	**-3.1%**	1.3%	**-3.5%**	**-3.6%**
% NMS 13*		2.2%	1.2%	4.8%	7.0%	8.1%	10.4%	9.8%	10.5%	4.6%	9.9%	7.1%	5.4%
% Annual change													
% EU 28		2.1%	**-1.1%**	2.8%	1.1%	0.2%	0.1%	**-1.7%**	0.4%	**-5.7%**	4.7%	**-4.5%**	**-0.3%**
% EU 15		2.0%	**-1.1%**	2.6%	0.9%	0.0%	**-0.2%**	**-1.8%**	0.3%	**-5.7%**	4.6%	**-4.8%**	**-0.1%**
% NMS 13*		2.2%	**-1.0%**	3.6%	2.1%	1.1%	2.1%	**-0.6%**	0.6%	**-5.3%**	5.1%	**-2.6%**	**-1.6%**

Fig. 9 shows the changes of final energy consumption per member states. The largest growth of final energy consumption is found in Lithuania, Latvia, Luxembourg and Estonia. UK, Portugal and Greece have undergone a reduction in the final energy consumption. Hungary, Slovakia and Czech Republic are the only new member states where final energy consumption declined

Fig. 9 Total growth of final energy consumption between 2000-2012.Data: Eurostat.



Final energy consumption per fuel types.

The main energy fuels of final energy consumption are petroleum products, gas and electricity, which provide the 39%, 22.9% and 21.8% of the final energy consumption in 2012 respectively (Fig. 11). Renewables, solid fuels and derived heat, have a total share of around 14%. The drop of 26 Mtoe in final energy consumption from 2000-2012, is the result of 88 Mtoe reduction in solid fuels, petroleum products and gas, while heat, renewables, electricity and waste grew by 61 Mtoe. This

shows that the final reduction of energy consumption is the result of diverse changes in the energy type mixture. For instance there has been a decline of 15 Mtoe in gas consumption but part of this energy gap has been covered by the increase of other energy types such as renewables, electricity and heat. In the same way, increases in electricity consumption can be due to substitution of gas or other energy sources, rather than a direct increase of electricity consumption for the same type of service.

Fig. 10 Share of energy types to final energy consumption. EU-28, 2012, Data: Eurostat

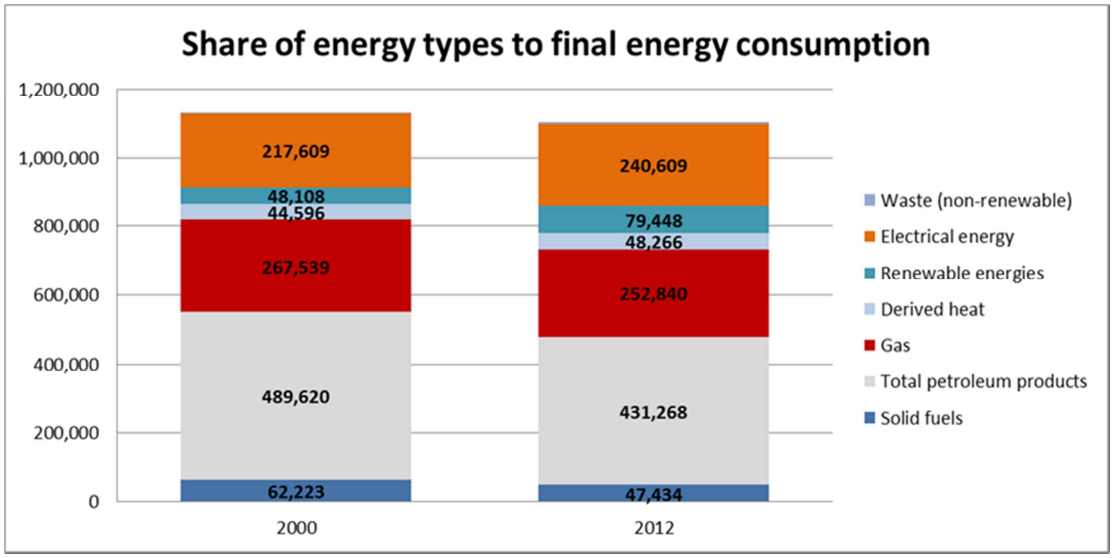
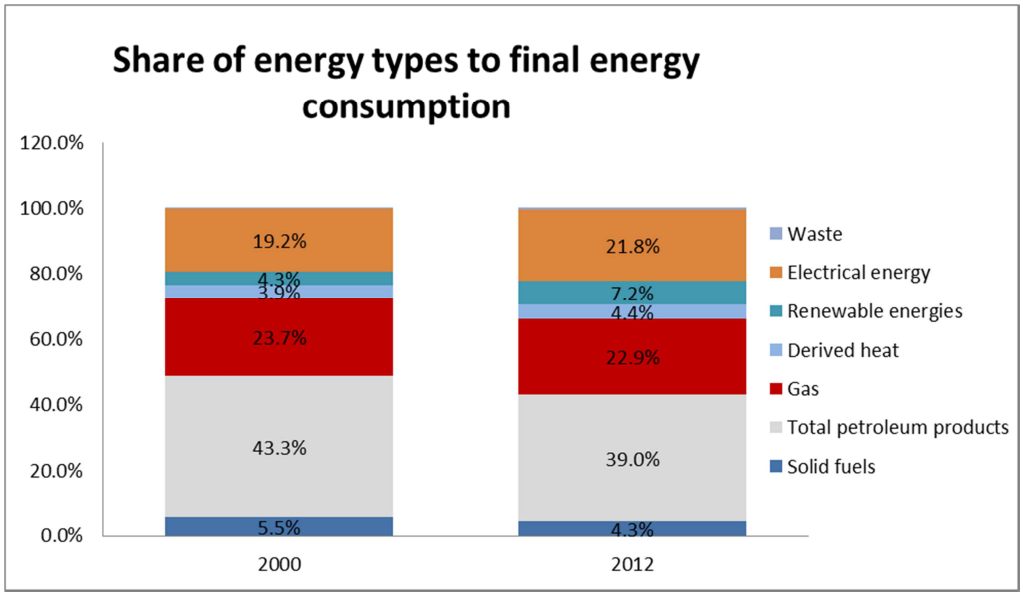


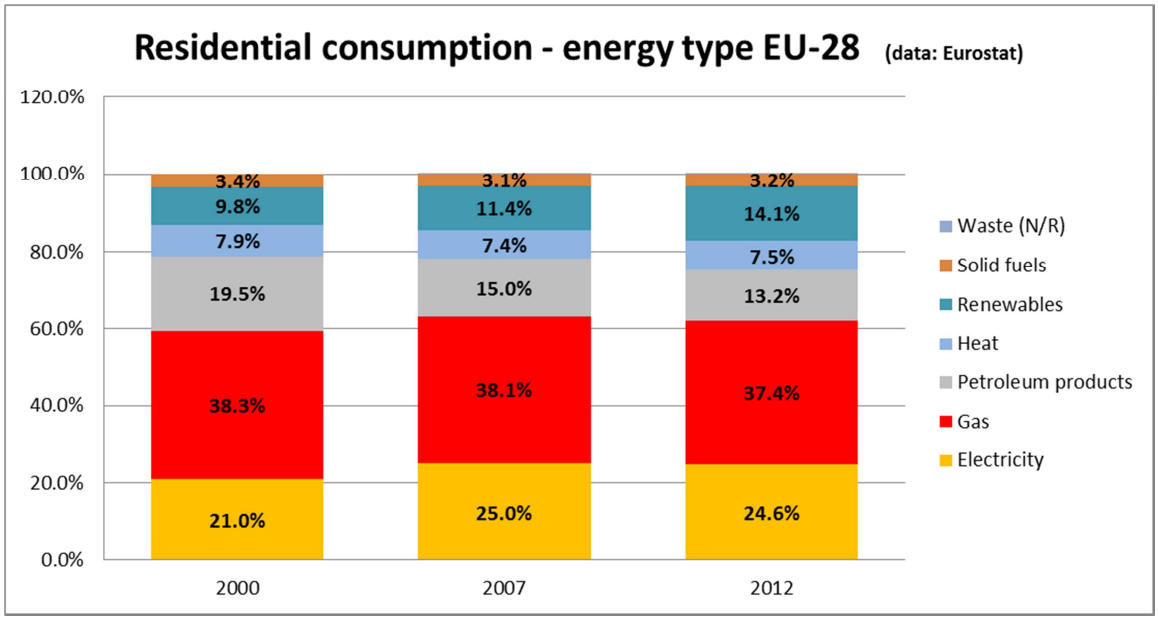
Fig. 11 Share of energy types to final energy consumption. EU-28, 2012, Data: Eurostat



2. Residential Sector

In 2012, residential energy accounted for 26.2% of the final energy consumption (Fig. 3). The energy fuels with the largest share are gas (37.4%) and electricity (24.6%). Renewables account for 14.1% of the energy supply, total petroleum products for 13.2% and heat for 7.5%. There have been some changes in the breakdown of energy types since 2000. The share of electricity and renewables has increased by 3.6% and 4.3% respectively. In contrast, gas decreased by 0.9% petroleum products by 6.3%, heat by 0.4% and solid fuels by 0.2%. Because of the importance of gas and electricity, a special focus will be given to these energy fuels for the residential sector.

Fig. 12 Shares of energy fuels for residential consumption in EU-28, 2000, 2007, 2012. Data: Eurostat.



In 2000 residential energy consumption in EU-28 was 294 Mtoe (Fig. 13). In 2012 it dropped to 289 Mtoe, a reduction of 1.8%. Residential consumption was higher than the 2000 levels from 2001-2006. After 2007 consumption dropped suddenly. Only in 2010 it was higher than the 2000 levels again, with an increase of 5.7%, which was also the highest point of all the period. This year however there was a very cold winter which could have driven the heating demands up (Fig. 14). In 2011 there was a sudden drop with consumption being 5.7% less than the 2000 levels. In 2012 it increased slightly again. From a comparison of Fig. 13 and Fig. 14, it can be seen how the changes in heating degree days relate to the changes in the residential energy consumption. In 2007 and 2011 there was a mild winter and the residential energy dropped accordingly. In 2010, when there was a very cold winter residential energy consumption went up. In EU-15 there was the same trend. In 2000, consumption was 246 Mtoe and in 2012 the number dropped to 239 Mtoe, a reduction of 2.8% (Table 3). The highest point of the period was in 2010 with an increase of 4.8% and the minimum in 2011 with a decrease of 7.3% compared to 2000. In 2012 consumption increased but the figure was still 2.8% less than the 2000 levels.

For NMS-13 residential consumption has always been higher than the 2000 levels, where it was 46 Mtoe. The rate of increase has varied during that period. The peak point was in 2010 with an increase of 10.3%. However then there was a slight decrease. In 2012 consumption was 51 Mtoe, which represents a growth of 3.7% compared to 2000.

Fig. 13 Residential energy consumption in EU-28, EU-15, NMS-13. 2000-2012. Data: Eurostat

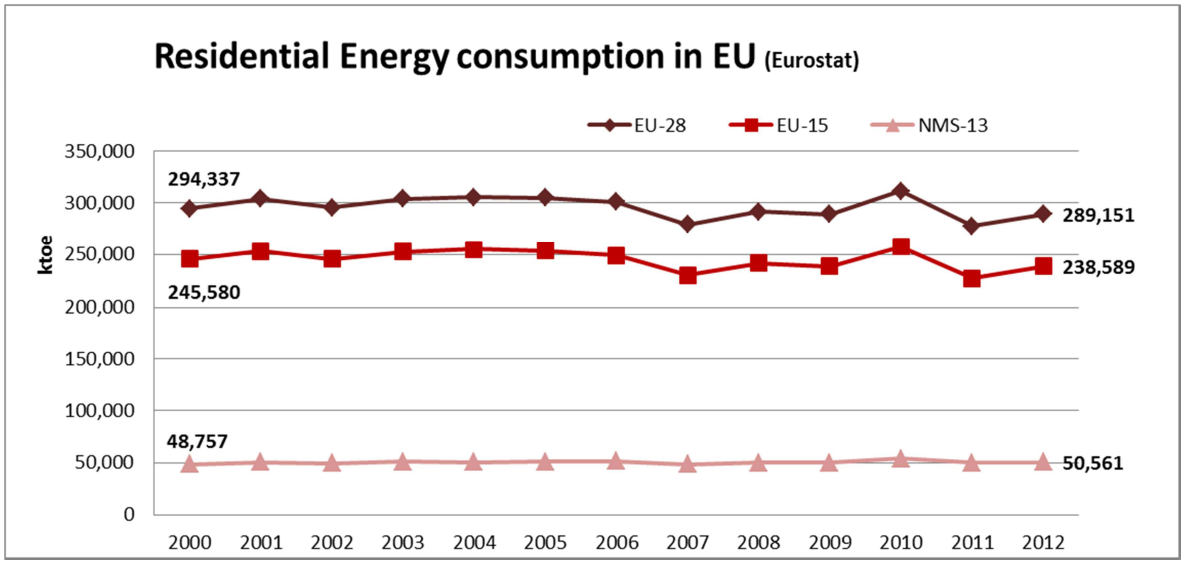


Fig. 14 Heating Degree Days EU-28, 2000-2012, Data: Odyssee

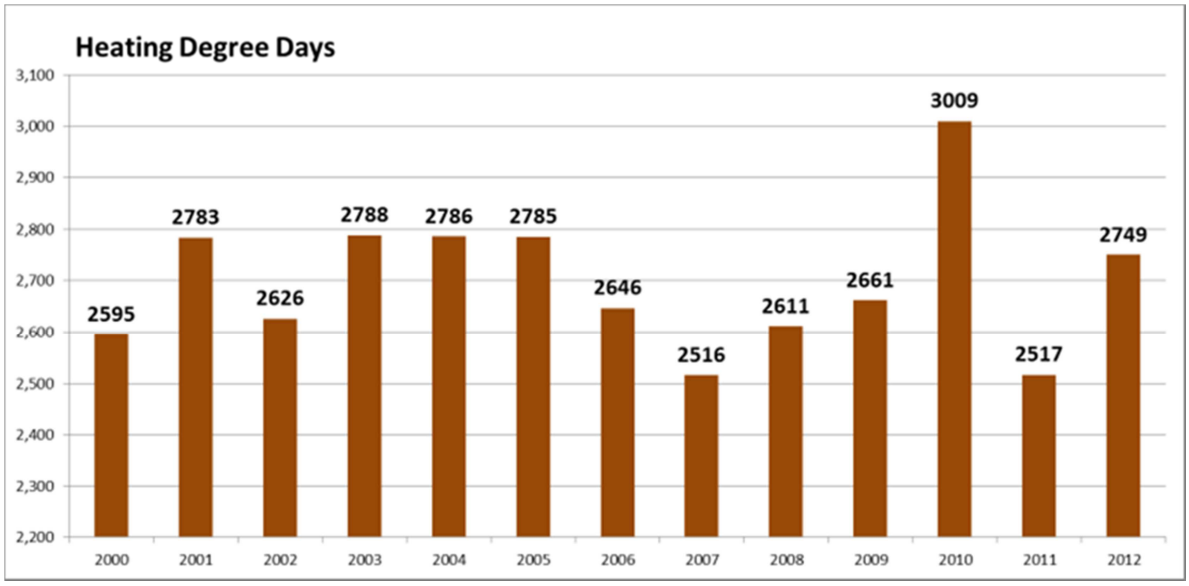


Fig. 15 Residential energy consumption EU-28 2000-2012 Data: Eurostat

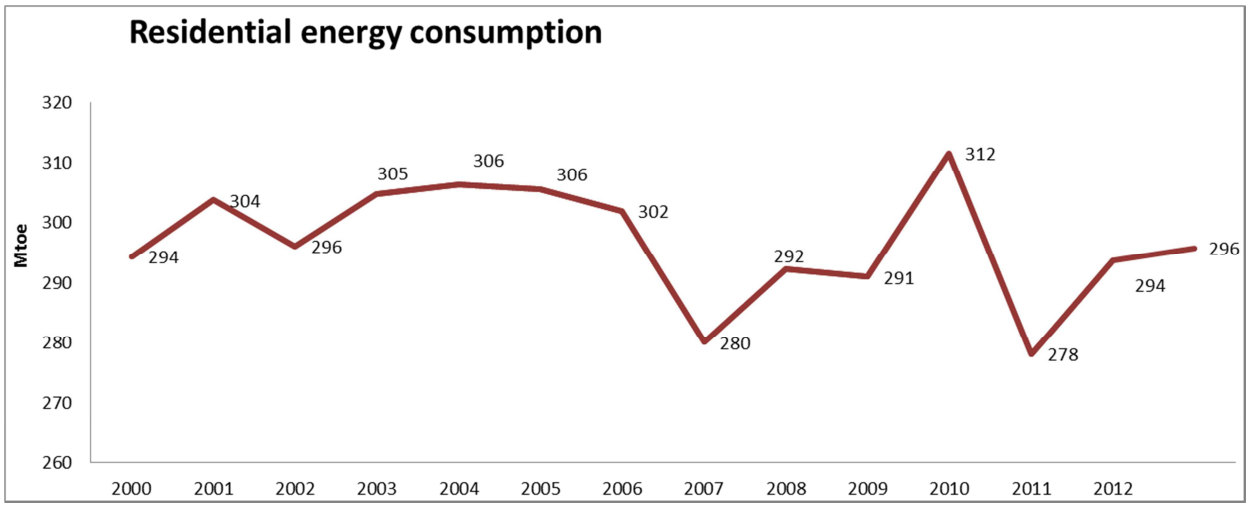


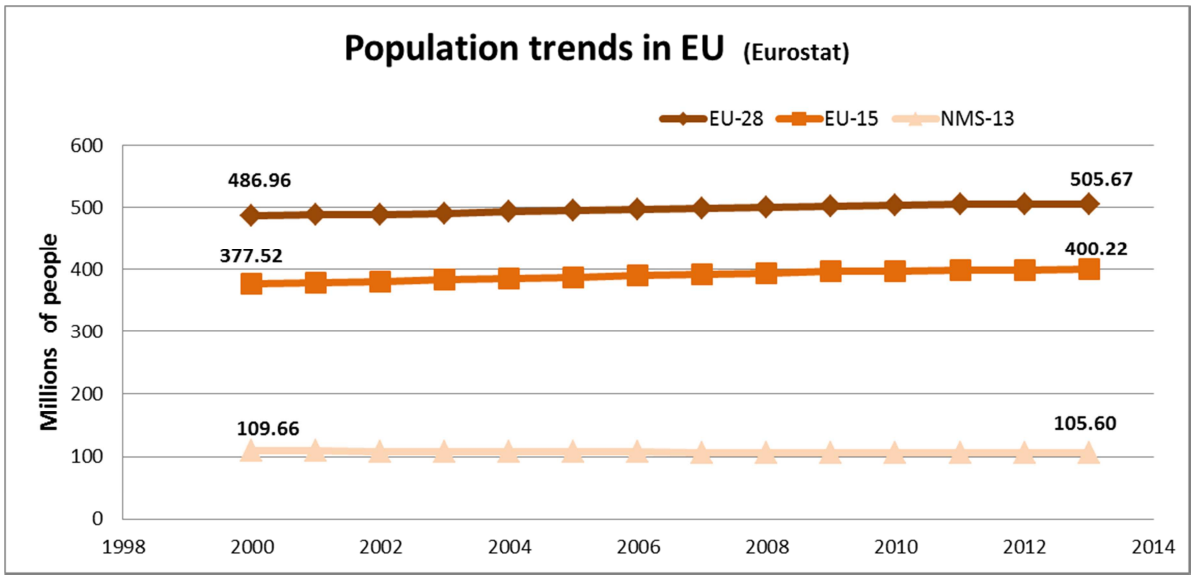
Table 3 Residential energy consumption, Annual Changes Data: Eurostat

	Residential Energy Consumption (ktoe)												
(ktoe)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	294337	303759	295246	303755	305329	304526	300929	279181	291349	288883	311059	277591	289151
EU-15	245580	253009	245816	252533	254890	253321	249238	230387	241497	238673	257261	227555	238589
NMS-13	48757	50750	49430	51222	50440	51205	51690	48794	49852	50210	53798	50037	50561
	% Change from 2000												
% EU 28		3.2%	0.3%	3.2%	3.7%	3.5%	2.2%	**-5.1%**	**-1.0%**	**-1.9%**	5.7%	**-5.7%**	**-1.8%**
% EU 15		3.0%	0.1%	2.8%	3.8%	3.2%	1.5%	**-6.2%**	**-1.7%**	**-2.8%**	4.8%	**-7.3%**	**-2.8%**
% NMS 13*		4.1%	1.4%	5.1%	3.5%	5.0%	6.0%	0.1%	2.2%	3.0%	10.3%	2.6%	3.7%
	% Annual change												
% EU 28		3.2%	**-2.8%**	2.9%	0.5%	**-0.3%**	**-1.2%**	**-7.2%**	4.4%	**-0.8%**	7.7%	**-10.8%**	4.2%
% EU 15		3.0%	**-2.8%**	2.7%	0.9%	**-0.6%**	**-1.6%**	**-7.6%**	4.8%	**-1.2%**	7.8%	**-11.5%**	4.8%
% NMS 13*		4.1%	**-2.6%**	3.6%	**-1.5%**	1.5%	0.9%	**-5.6%**	2.2%	0.7%	7.1%	**-7.0%**	1.0%

Population

When looking at energy consumption statistics it is important to consider other factors influencing energy consumption such as economic development, weather conditions and population. No quantitative analysis aiming to assess the influence of these factors is presented in this report. Nevertheless, possible explanations for consumption patterns can be attempted by simply comparing energy consumption with the trends observed for some of these factors. In the following section, the trends of the following parameters will be considered: Population, GDP per capita, weather conditions (actual heating degree days), number of dwellings per member state, average persons per household. This can in principle help to better understand the relation between energy consumption and efficiency trends in the residential sector. For instance, a decrease of total energy consumption could be explained by a decreasing population and not by a more efficient use of energy.

Fig. 16 Population in EU-28, EU-15, NMS-13. 2000-2012. Data: Eurostat



Between 2000 and 2012 population in the EU-28 grew by 3.6% (

Table 4). In the same period residential energy consumption fell by 1.8% but residential energy consumption per capita fell even more, by 5.2%. In the EU-15 population increased by 5.7%, residential energy decreased by 2.8% and residential energy per capita decreased by 8.1%. On the contrary, in NMS-13 population decreased by 3.5%, residential consumption grew by 3.7% and residential energy per capita increased by 7.5%. Therefore when considering population, the reduction of residential energy per capita was larger in EU-15, while in NMS-13 there was a larger growth of residential energy per capita.

Fig. 17 Residential energy consumption per capita, EU-28, EU-15, NMS-13 for 2000-2012. Data: Eurostat

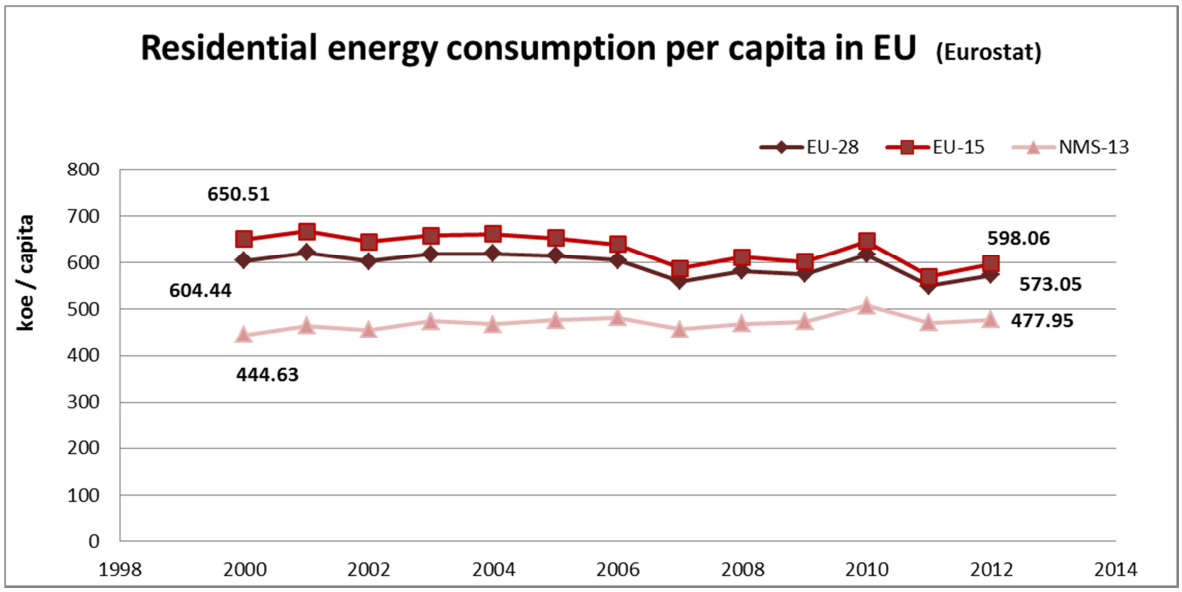
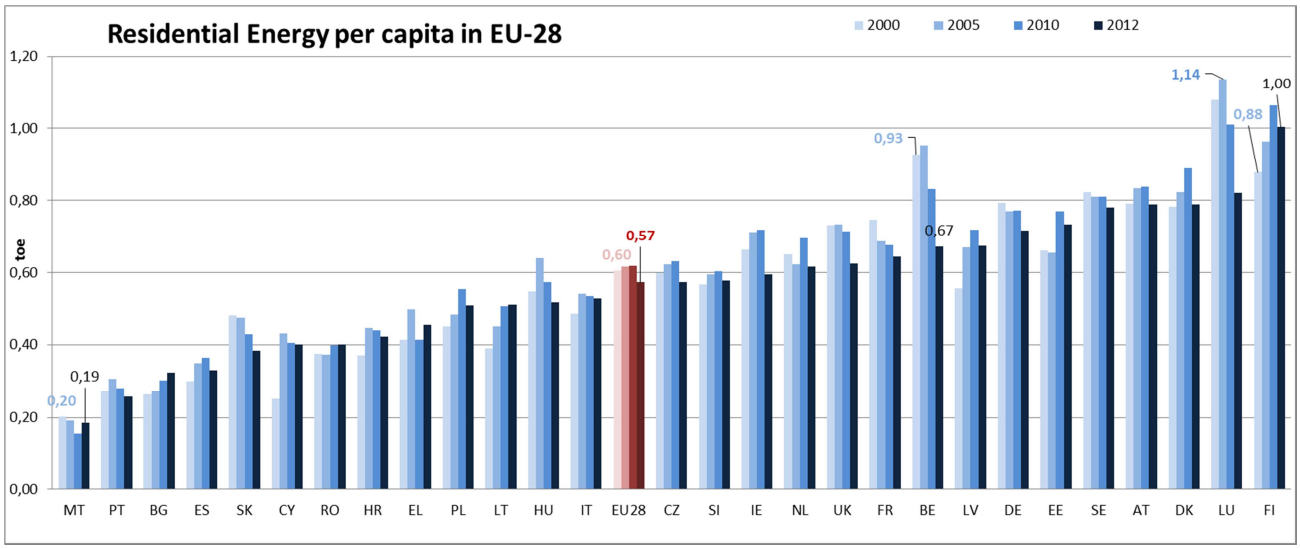


Fig. 18 Residential Energy per capita for Member States, 2000,2005,2010,2012 Data: Eurostat.



Although per capita residential consumption in EU-28 has decreased slightly since 2000 (

Fig. 18), when looking into member states, there have been significant changes in consumption. Finland has the highest consumption per capita and Malta the lowest. In Finland there is high demand for heating and the use of saunas is spread. Malta on the other side, has very low heating degree days. In most of the fifteen member states that had higher than EU-28 average consumption in 2012, there has been decline of the consumed energy compared to 2000. Finland, Latvia and Estonia are the only member states belonging to this category, where energy consumption grew further from 2000-2012. Significant decline of the consumption can be observed for Belgium and Luxembourg who had two of the highest consumptions in 2000. Besides Malta, other member states that rank very low in the residential energy per capita are Portugal, Spain and Cyprus, all of which have warm climates. However Bulgaria, Romania and Slovakia who have very low residential energy consumption have not so low HDD (

Fig. 42). In most of the member states with lowest than EU average residential energy per capita consumption, consumption grew compared to 2000. Exceptions are Malta, Portugal, Slovakia and Hungary, where consumption declined. Therefore there is a trend that shows that the value for the per capita residential consumption of the different member states moves closer towards the EU-28 average compared to 2000, which means that the difference in the consumption patterns in different member states, becomes smaller.

Because of the interdependence of the heating degree days (HDD) with the residential energy consumption, it is interesting to see how the residential energy has evolved normalized by the HDD.

Fig. 19 shows the residential energy per capita divided by the heating degree days. In EU-28, there is decline from 2000-2012. In EU-15, with the exception of 2011, there was a gradual downward movement after 2006. In NMS-13 there was decline between 2008 and 2010, but after 2010 there is growth. Overall in EU-15 there has been decline while in NMS-13 there has been a slight growth of this indicator.

Fig. 20 shows these changes for individual member states. Most of the NMS-13 rank very low compared to EU-15. That could explain why there was still growth in the energy consumption as calculated in

Fig. 19. Cyprus and Malta are an exception, they have higher than average residential energy consumption per capita and HDD.

Fig. 19 Residential Energy per capita per HDD Data: Eurostat, Odyssee

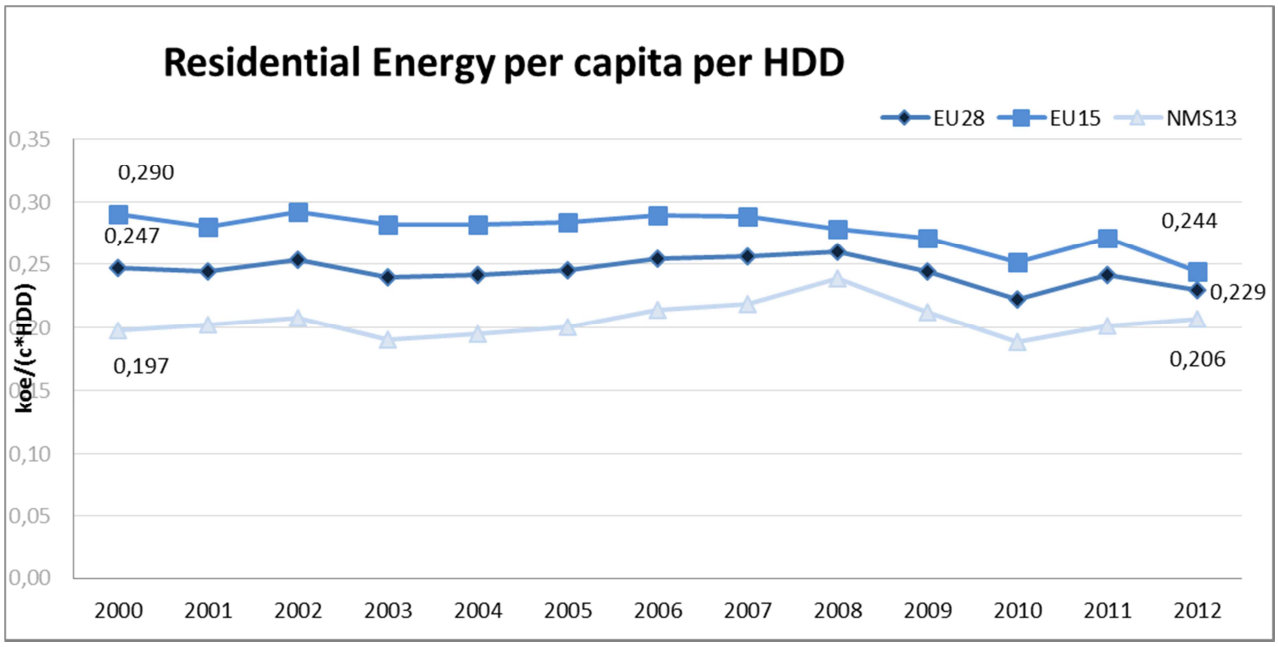
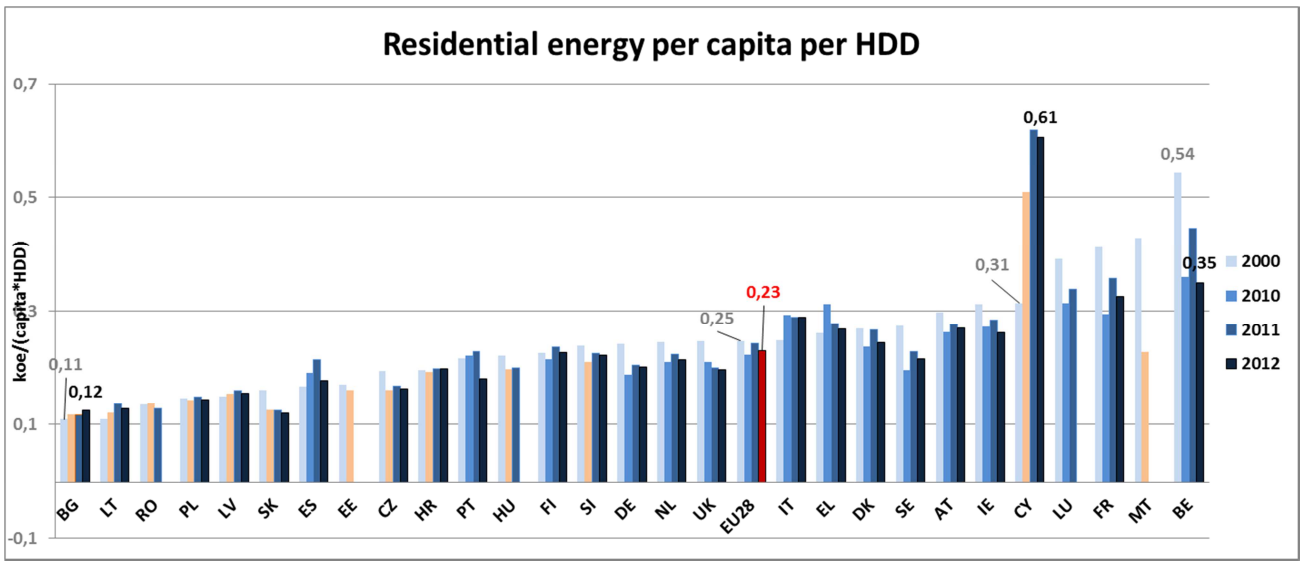


Fig. 20 Residential energy per member state[1], per capita and HDD, Data: Eurostat, Odyssee



[1] Orange colour indicates NMS-13

Gross Domestic Product (GDP)

Another factor that can influence energy consumption is the economic development and economic situation of the member states. GDP per capita has been increasing during 2000-2012, with a drop in GDP in 2009 due to the economic and financial crisis (Fig. 21). After 2009, GDP per capita increased again. In 2011, GDP reached again similar levels as those of 2008, before the crisis. The growth in GDP per capita is connected to important economic development during these years which can affect energy consumption in multiple ways. It can result in increase of residential energy

consumption, by increased comfort levels, but it can also be accompanied by more efficient ways of energy usage. In the household sector, increase in efficiency is mainly due to more efficient appliances and equipment, more efficient heating systems and better insulated buildings, most of which require larger initial investments.

Fig. 21 GDP per capita in market prices, EU-28, EU-15, NMS-13, 2000-2012. Data: Eurostat

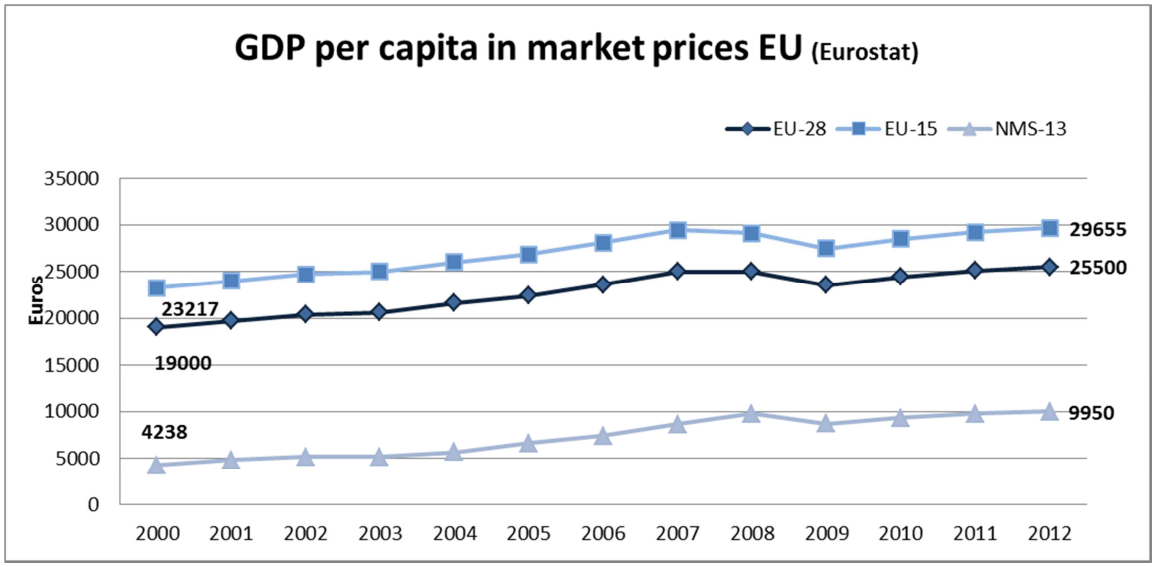


Table 4 Population, per capita residential consumption, per capita GDP changes on 2000-2012. Data: Eurostat

	Population		Residential per capita ktoe/c		GDP per capita	
	2000	2012	2000	2012	2000	2012
EU-28	486,958,178	504,582,506	604	573	19,000	25,500
EU-15	377,516,035	398,939,918	651	598	23,217	29,655
NMS-13	109,659,290	105,788,067	445	478	4,238	9,950
% Change						
% EU 28		3.6%		-5.2%		34.2%
% EU 15		5.7%		-8.1%		27.7%
% NMS 13*		-3.5%		7.5%		134.8%

By comparing the changes in GDP per capita and residential consumption per capita since 2000 (Table 4 & Fig.22), it is seen that in NMS-13 for an increase of GDP per capita by 135%, residential energy per capita increased by 7.5%. In EU-15, for GDP increase of 27.6% residential energy declined by 8.1% and in EU-28, for an average increase of GDP per capita of 34.2% there was a decline of 5.2%. Therefore in NMS-13, which had on average low GDP but also low residential consumption per capita, the consumption grew as a result of GDP growth. On the other side, in EU-15 where there was higher GDP per capita and high residential energy consumption per capita, further GDP growth led to reduction of the energy consumption.

Fig. 22 GDP per capita changes in EU-28, EU-15, NMS-13, 2000-2012. Data: Eurostat

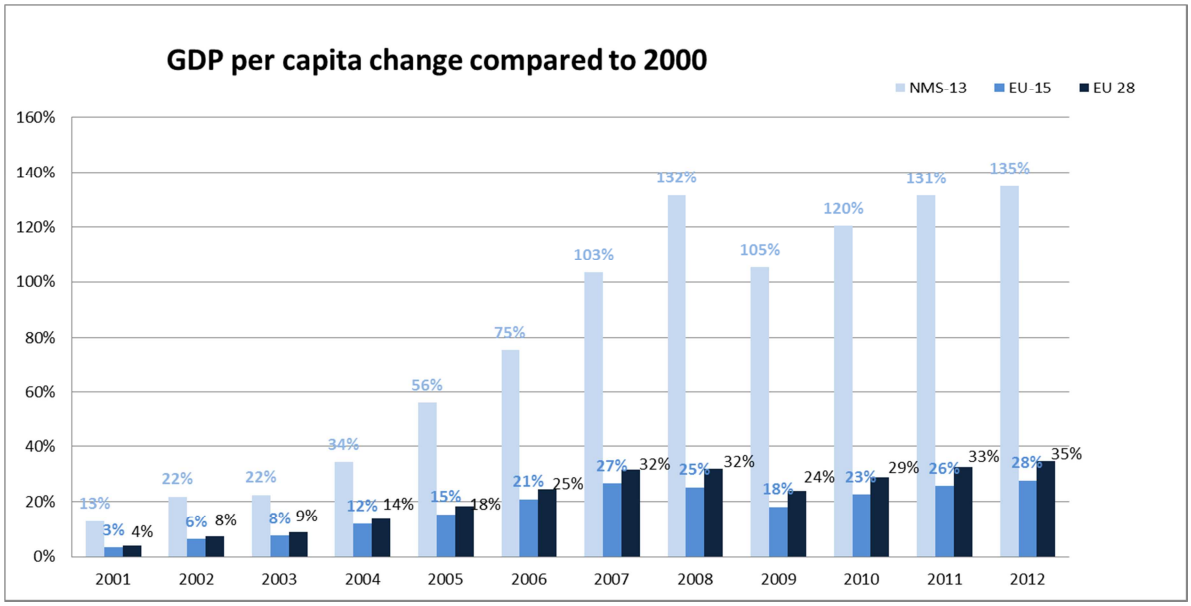
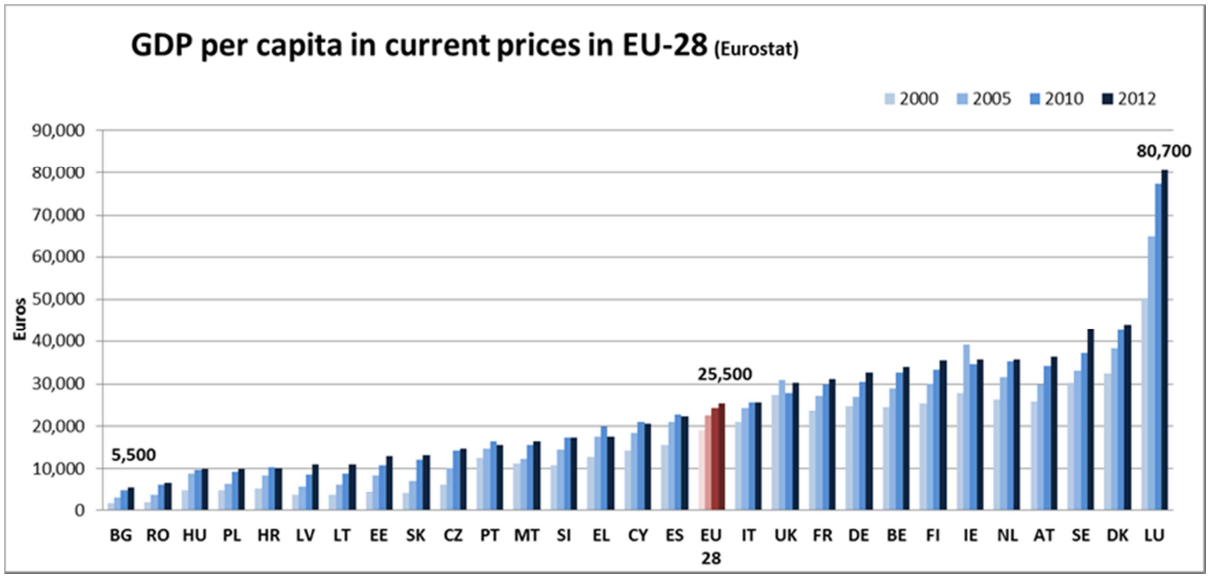


Fig. 23 shows the GDP per capita for different member states and for different years. In all of the member states GDP per capita has grown. Moreover, besides the high rate of growth in NMS-13 (Fig. 22), the actual GDP in these member states, is still much lower compared to member states that had already above EU-average GDP per capita. Therefore GDP growth in member states with below average GDP could have led to more consumption of residential energy, increasing comfort levels. On the contrary, in EU-15 the same levels had already being achieved and therefore it is possible that GDP growth, instead of being used directly for additional energy consumption was invested for more energy efficient equipment.

Fig. 23 GDP per capita for different Member States. 2000,2005,2010,2012 Data: Eurostat.



Due to the large diversity in the GDP per capita across the member states, it is of interest to relate this to the residential energy consumption per capita for different member states. The member states with the highest consumption per capita (Finland, Luxembourg, Denmark, Sweden and Austria), have also above average GDP per capita. Higher GDP levels may indeed lead to buy more

energy-using equipment at home resulting hence in higher energy consumption. But as already mentioned above, economic growth can also lead to more energy efficient equipment resulting in lower energy consumption levels. An indication for that is that the member states with the highest GDP per capita (Luxembourg, Denmark, Sweden, Austria) have not experienced significant growth in the residential energy per capita compared to 2000.

Fig. 24 shows the per capita residential consumption divided by the per capita GDP. The trends show that there is gradual decline of this indicator for most of the member states, with the exception of Cyprus where it remained almost the same. On average in EU-28, per capita residential consumption divided by per capita GDP, has decreased by 30% since 2000. The decrease is very sharp in the case of NMS-13, something that could be related to the increase of GDP for the same period. Luxembourg and Malta have the least residential consumption per GDP while the highest values are found for Romania and Latvia.

Fig. 24 Residential Consumption per GDP for member states, 2000,2005,2010,2012 Data: Eurostat.

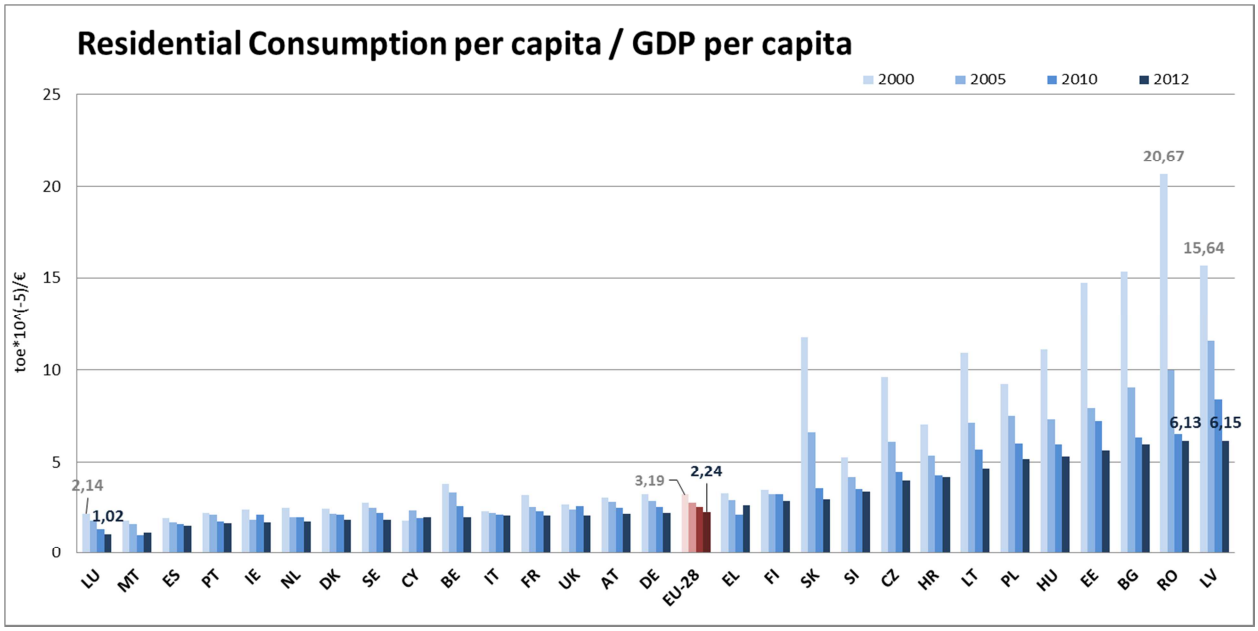


Fig. 25 shows the Residential energy per capita, after it has been normalized for the GDP and HDD, and Fig. 26 shows the same information for different member states. First, it can be seen that NMS-13 have higher values compared to EU-15. In both cases however there is decline of this indicator. In addition it looks as if the values for the different member states will converge into the same point in the future. This could indicate that there is an optimal point where there is a similar combination of residential energy consumption per GDP and HDD. Fig. 26 shows that the lowest values belong to Luxembourg, Denmark and Finland all of which are member states with large GDP and HDD. Hungary, Bulgaria and Romania have the highest values, but there has been significant decline. In general, this indicator has changed more for NMS-13. With the exception of Cyprus, in all the other member states there has been decline compared to 2000.

Fig. 25 Residential energy per capita, normalized by HDD and GDP per capita Data Eurostat, Odyssee

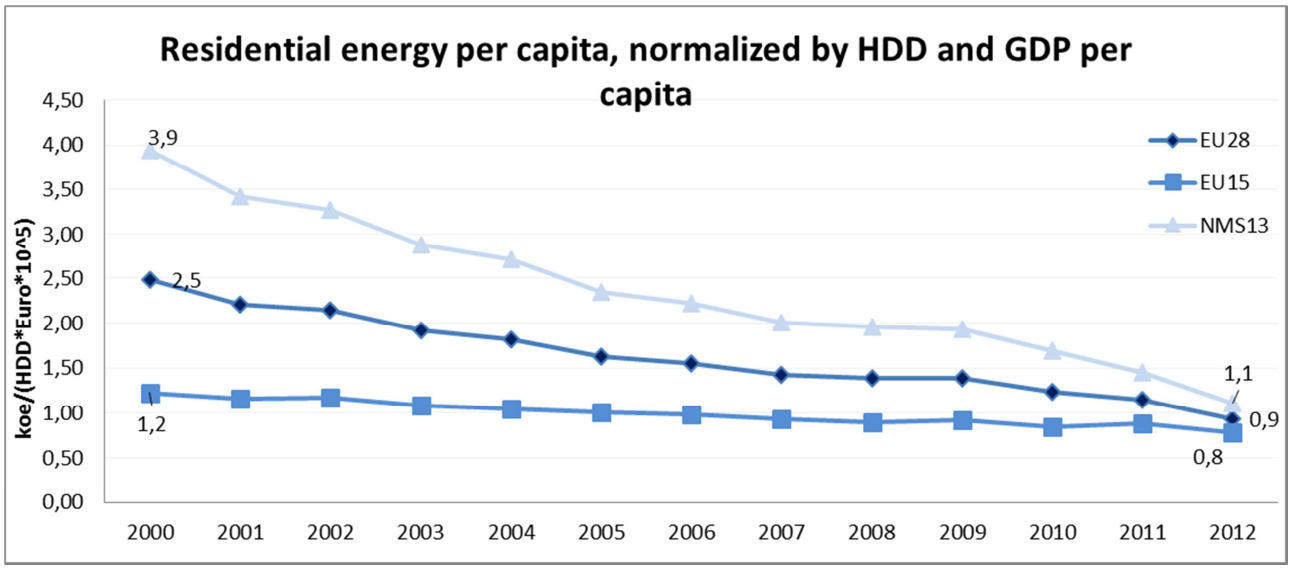
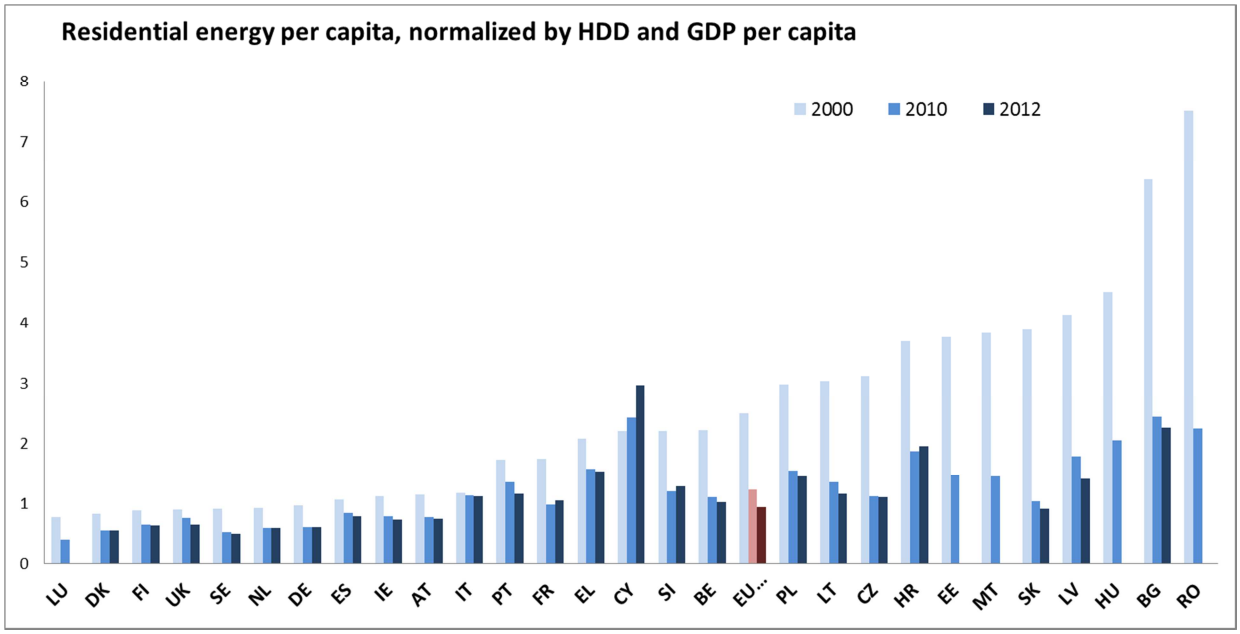


Fig. 26 Residential energy per capita, normalized by HDD and GDP per capita for Member States Data Eurostat, Odyssee



Household and Dwelling size

Residential consumption is influenced by other factors as well, such as the dwelling and the household size. A household is a group of persons who share the same living accommodation and who consume certain types of goods and services collectively, mainly housing and food[2]. Therefore the number of households is different than the number of dwellings. The average household size in 2012, in EU-28 was 2.3 persons per household (Fig. 27). Single and small households have a higher per capita consumption than large family households. Most energy- using equipment is shared by the people living together in one household, especially heating and cooling, white appliances and

electronic equipment. Sweden had the lowest average number of people per household (1.9) and Romania the highest (2.9). Generally, there is a negative correlation between household size and economic development. People in wealthier member states tend to live in smaller households whereas large households are often identified in member states with below average per capita GDP. The overall development in Europe is an increase in the number of smaller households which leads to an increase of energy consumption per household.

Fig. 27 People per Household in Member States. 2005, 2012 Data: Eurostat.

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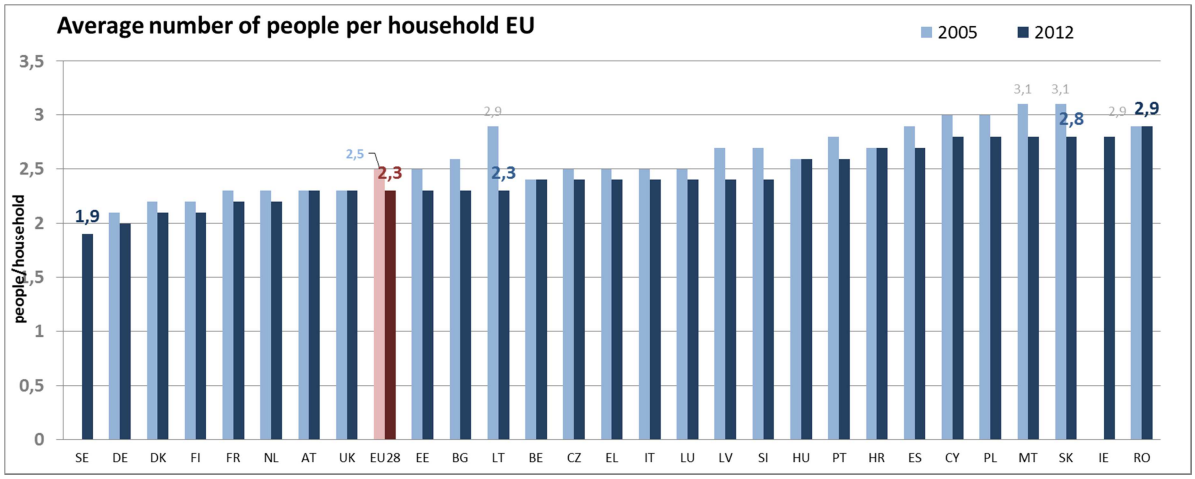
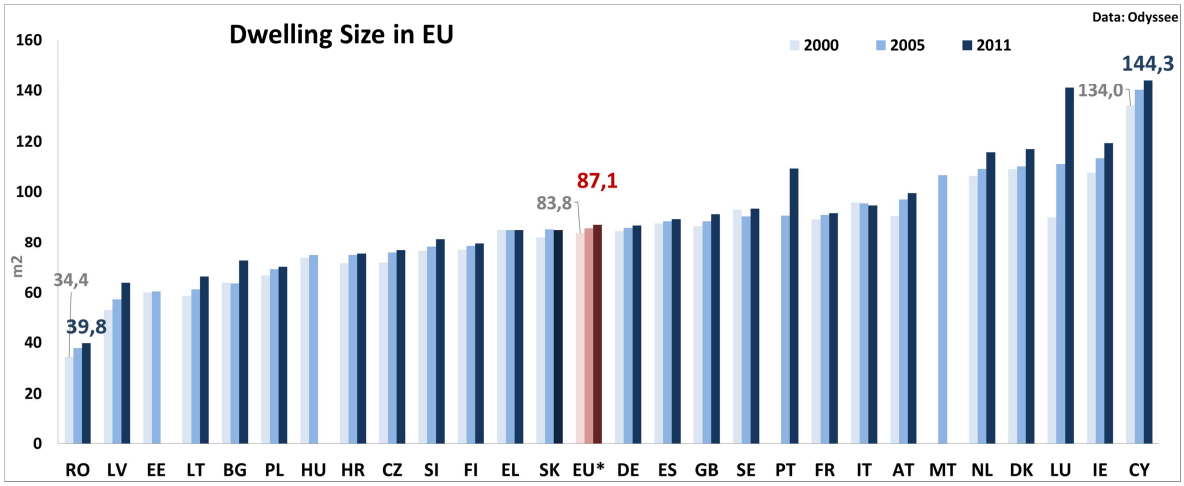
http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=DSP_GLOSSARY_NOM_DTL_VIEW&StrNom=CODED2&StrLanguageCode=EN&IntKey=16492135&RdoSearch=BEGIN&TxtSearch=household&CboTheme=&IsTer=&IntCurrentPage=1&ter_valid=0



Dwelling size, measured in m^2 is another important aspect (Fig. 28). The average dwelling size in EU has increased by 3.9% from 83.8 to 87.1 square meters. Large dwellings generally have a higher heating and cooling demand and higher energy consumption by lighting equipment. Romania has the smallest dwelling size besides being the member state with the maximum people per household. Latvia, Lithuania and Poland have also small dwelling size. Member States with large dwellings are Cyprus, Luxembourg, Ireland, Denmark and Netherlands. Those member states, with the exception of Cyprus, have higher than average residential consumption per capita. In addition, member states with higher than average dwelling size, tend to have large GDP per capita, which shows that economic development and dwelling size are positively correlated. In almost all of the member states there is a gradual increase of the floor area of dwellings which could lead to an increase of heating demand.

Fig. 28 Average floor area of dwellings in Member States. 2005, 2012 Data: Odyssee.



The trends for dwelling size are not always indicative for residential consumption per dwelling.

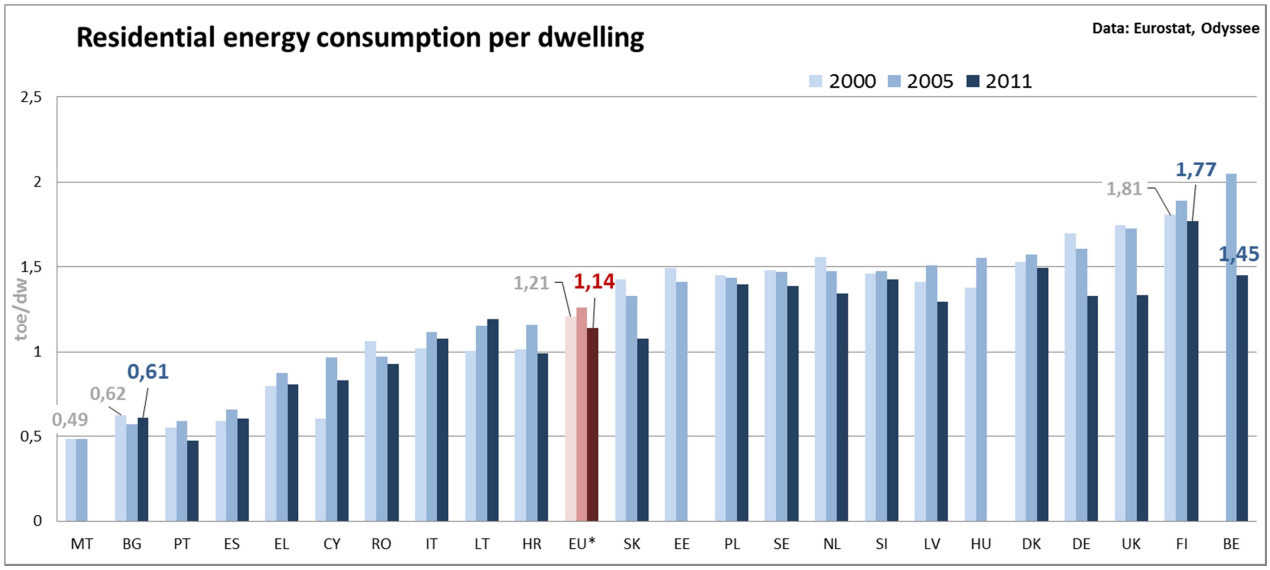
Fig. 29 shows the residential consumption per dwelling between different member states. The average final residential energy consumption per dwelling in the EU[3] in 2011, was 1.14 toe/dw and in 2000 it was 1.21 toe/dw, a decline of 5.8%. In contrast, average dwelling size has increased by 3.9%. Malta, Bulgaria and Portugal have very low consumption per dwelling, while Finland and Denmark

[3] Incomplete dwelling data for AT, CZ, EE, FR, HU, IE, LU and MT, were not used

have very high. Belgium had one of the highest consumption in 2005, but in 2011 there was large reduction. Most of the member states, that have large dwellings (Fig. 28), have also larger than average energy consumption per dwelling (

Fig. 29). However there are member states such as Cyprus, Italy, Spain and Portugal, that besides the large dwelling size, have less than the average consumption. This could be related to differences in heating degree days or per capita GDP

Fig. 29 Residential consumption per dwelling in Member States. Data Eurostat, Odyssee



Residential consumption per dwelling varies over time, however it can be seen in

Fig. 30, that the values are lower after 2007 compared to those before. An exception is in 2010 when it rose to 1.25 toe/dw, which is similar to the value in 2006. In 2011 it dropped again reaching the minimum for the period after 2001. These variations are similar to the variations in the heating degree days. In 2007 there was a drop in heating degree days and on 2010 a high peak. However it can be seen that the decrease in consumption per dwelling, is higher than what could be explained by the heating degree days alone. For instance in 2009 the heating degree days were higher than those of 2006 and 2002, but consumption did not reach again the levels of those years. Also in 2010, HDD reached the maximum of the period 2000-2012, while the residential energy per dwelling only reached the levels of 2006. Last in 2011, HDD increased again at higher values than 2007-2008, but dwelling consumption dropped to the minimum of the period 2001-2011.

Fig. 30 Residential energy per dwelling in EU-20[3] comparison with HDD[4] , 2001-2011. Data Eurostat, Odyssee

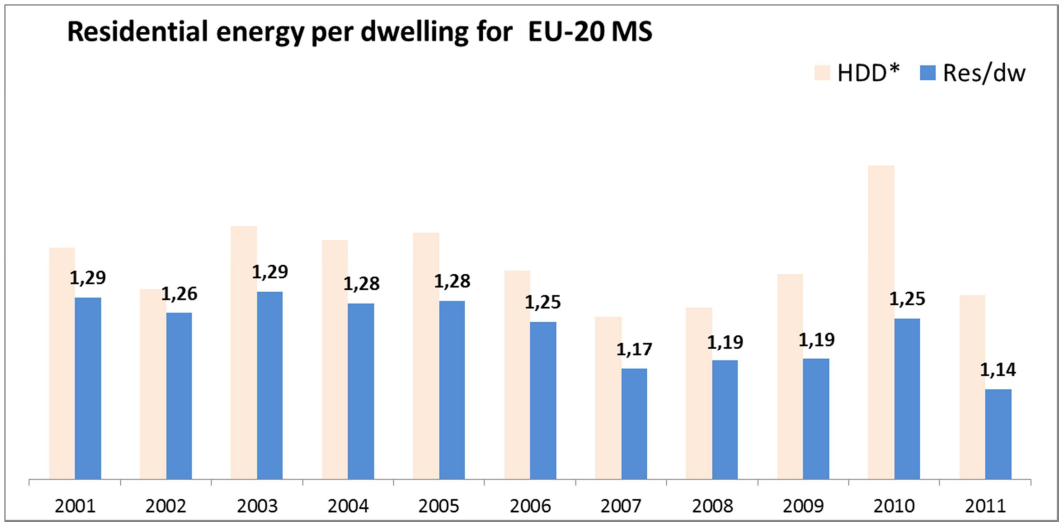


Fig. 31 shows the residential energy per dwelling and per HDD. It shows the diversity between the different member states. The member states with light orange belong to NMS-13. Although Cyprus in Fig. 26 (Residential energy per capita, HDD, GDP) was the only member state with increasing value from 2000-2012, in

Fig. 31 where it does not take GDP per capita into account, it can be seen that there has been decline in the energy consumption from 2001-2011. Decline of the residential energy per dwelling and per HDD can be seen in six out of nine NMS-13 and in four out of the eleven EU-15 member states included in this diagram. Fig. 32 shows the average residential energy per dwelling and HDD for the 20 member states with available data. On average there is decline. The sudden drop in 2010 could be related to the high number of HDD. Due to the very cold weather this year, the residential energy increased to match the demand for heating. However it is possible that the growth of consumption was not as high as needed in order to match the very large heating demand.

[4] HDD values have been adapted for comparison with residential energy per dwelling

Fig. 31 Residential energy per dwelling normalized by HDD for 20 members states[3]. Data: Eurostat, Odyssee

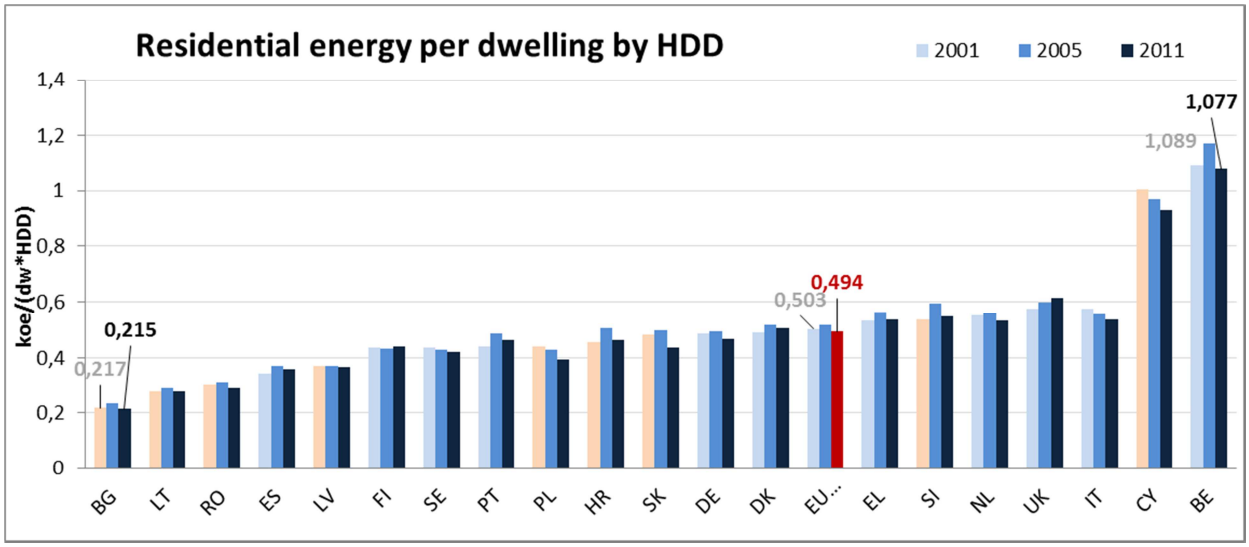
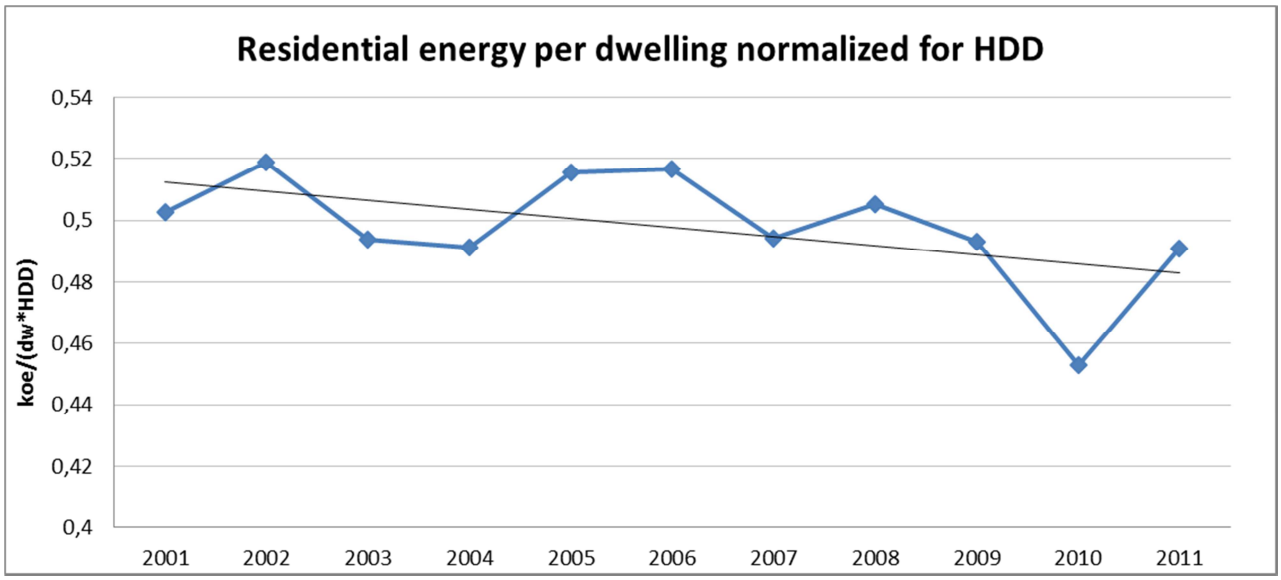


Fig. 32 Residential energy per dwelling normalized by HDD for the average of 20 members states[3]. Data : Eurostat, Odyssee



Floor Area

Due to the differences in average dwelling sizes between member states, it is also interesting to see how the energy consumption varies over the floor area. Average floor area has been increasing steadily from 2000 onwards. The residential energy per floor area for 2011 can be seen in Fig.34. Portugal, Cyprus and Spain have the lowest residential energy per floor area, while Romania, Finland and Latvia have the highest values. Romania has one of the smallest floor areas and that could explain why it ranks very high. When looking at the residential consumption per floor area compared

Fig. 36, the changes follow very similar patterns with the changes of HDD. It can be seen also that the last years the difference between the two columns is increasing.

Fig. 33 average floor area per capita for 18 member states[5], Odyssee, Eurostat.

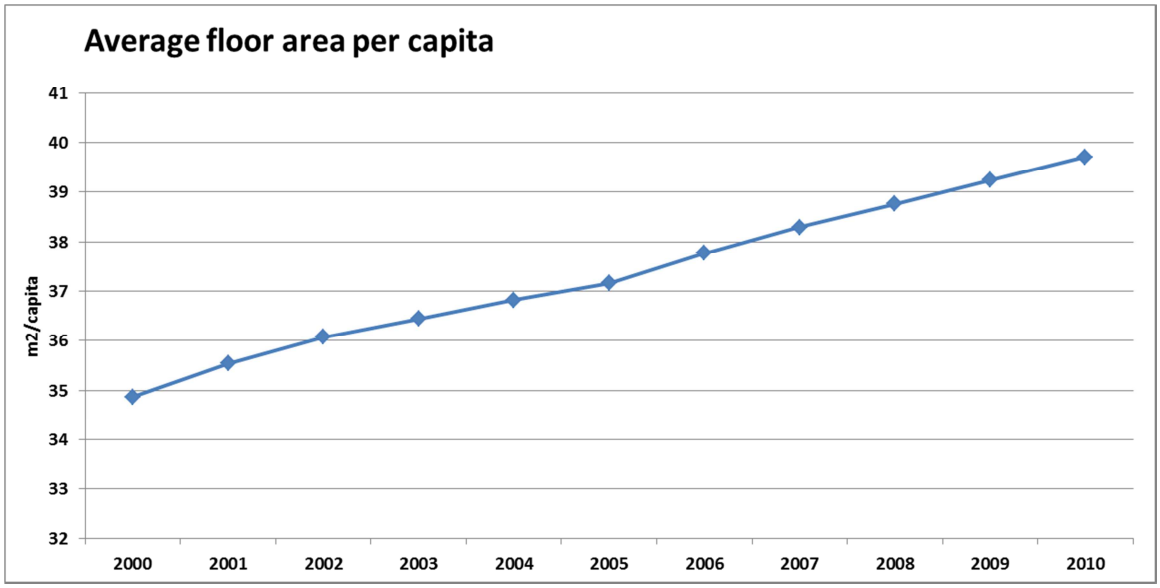


Fig. 34 Residential energy per floor area in 2011 for EU 18 member states[5]. Data Eurostat, Odyssee

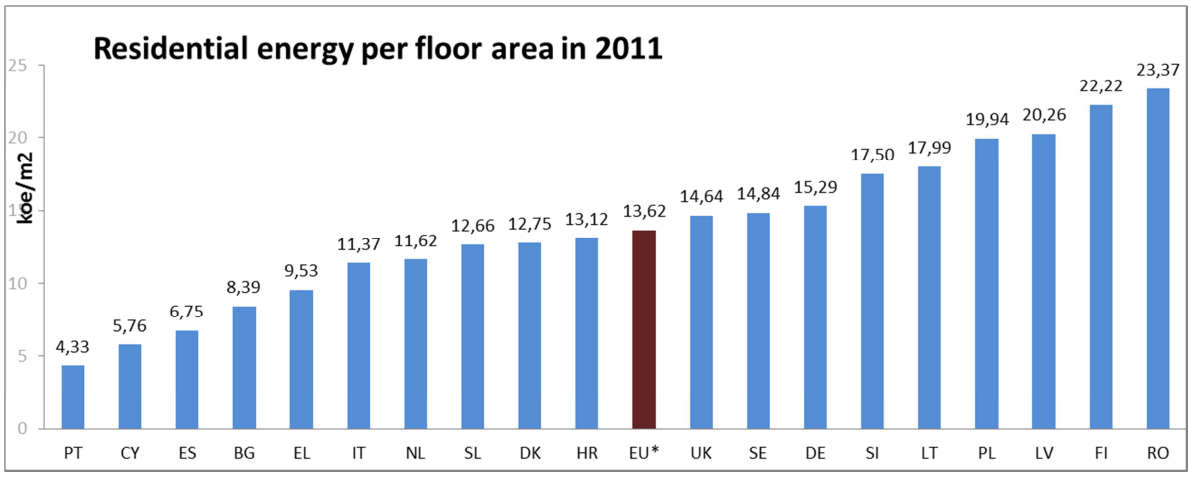
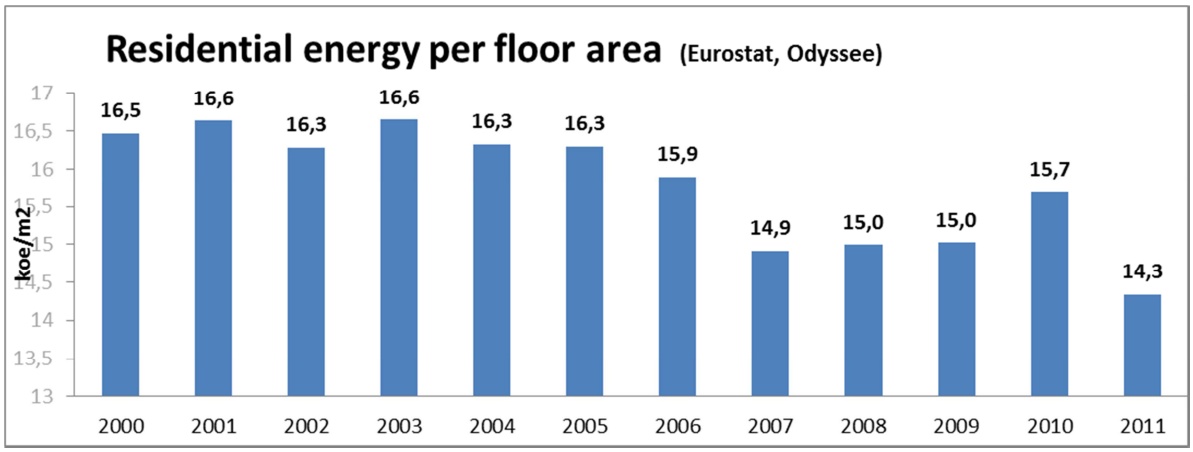
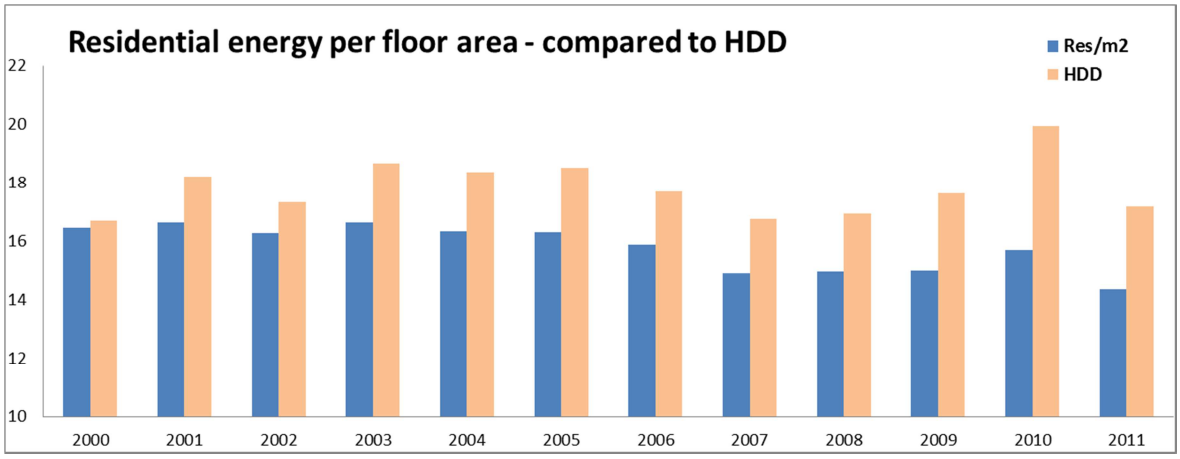


Fig. 35 Residential energy per floor area in EU-18[6]* for 2000-2011 Data Eurostat, Odyssee



[5] Floor area data incomplete for AT,BE,CZ,EE,FR,HU,IE,LU,MT and PT.

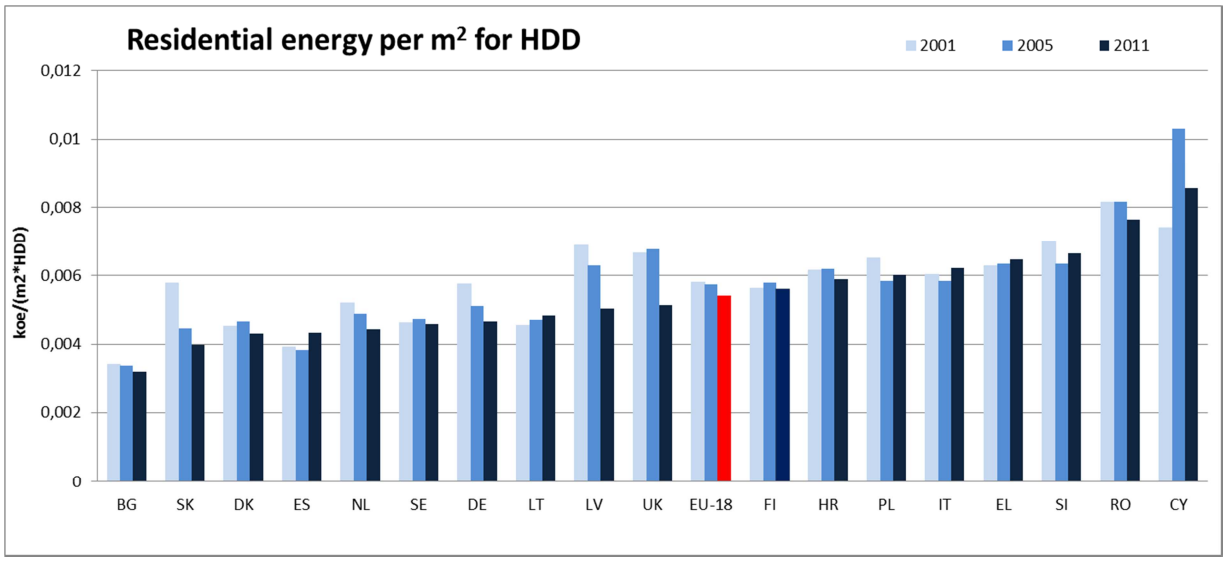
Fig. 36 Comparison of energy per floor area with HDD[7] for 18 Member states. Data Odyssee, Eurostat



By using the dwelling size for each different member states, it is possible to correct

Fig. 31 (Residential energy per dwelling and HDD) for differences in average dwelling size between different member states. Fig.37**Error! Reference source not found.** shows the residential energy per square meter and per HDD for different member states. In half of the member states (nine out of the eighteen), there has been a decline in 2011 compared to 2001. Six of the member states with the decline belong to new member states. By calculating the average of these member states from 2001-2011 it can be seen that overall there is a decline (Fig.38**Error! Reference source not found.**)

Fig. 37 Residential energy per m2 normalized by HDD for EU [8]. Data: Eurostat, Odyssee



[7] HDD values % 150 to match the same scale

Fig. 38 Residential energy per square meter for HDD for EU[5]. Data Odyssee, Eurostat

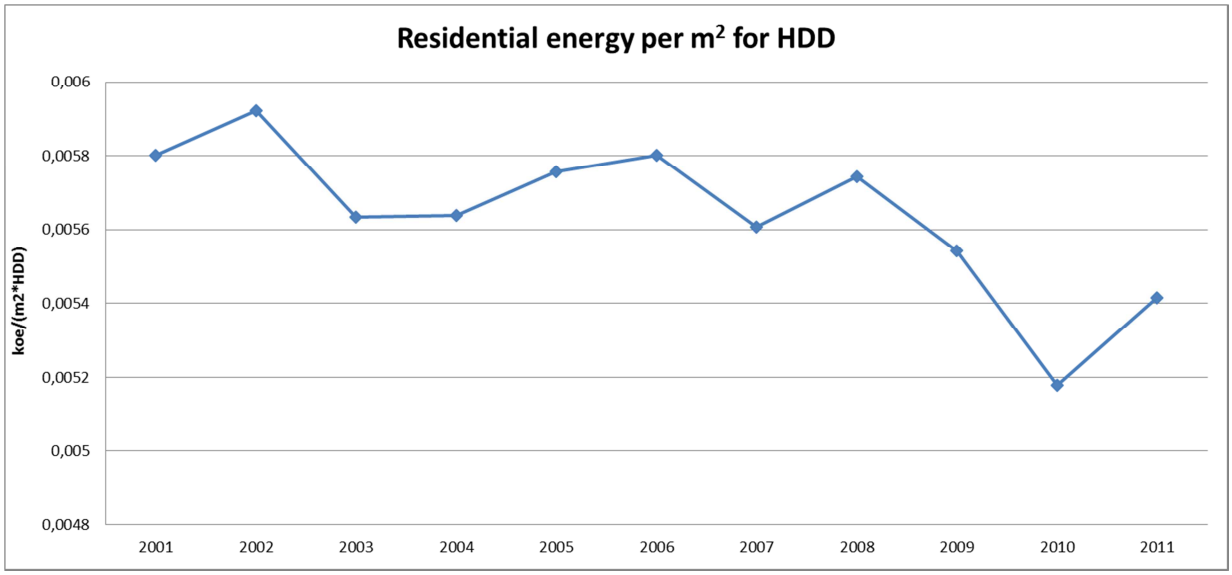
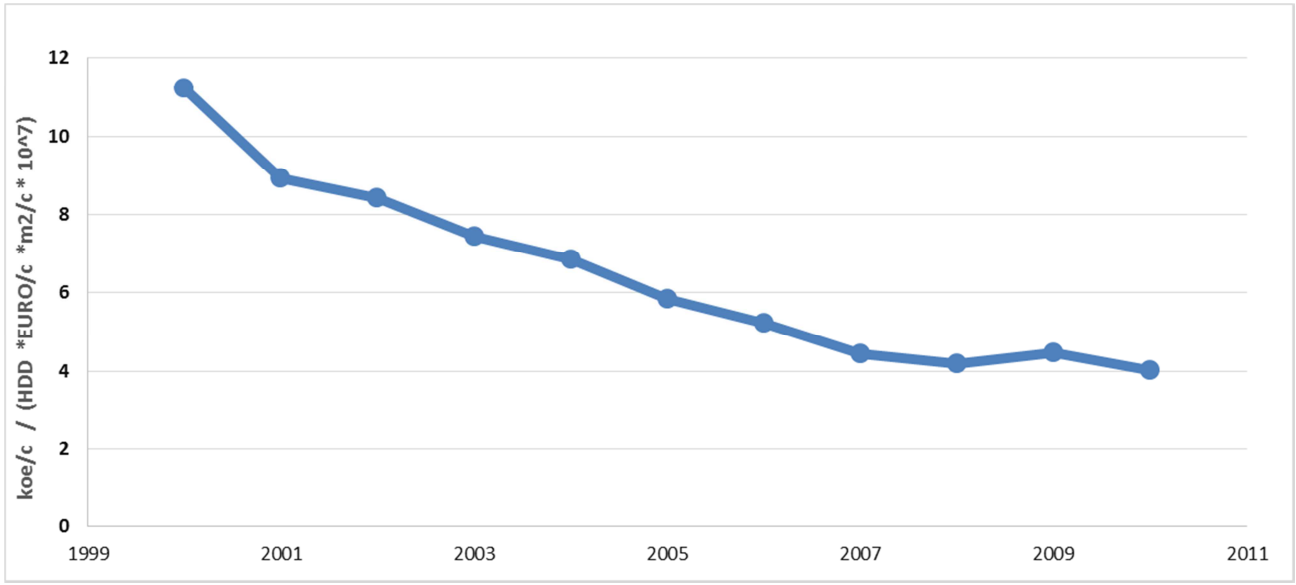


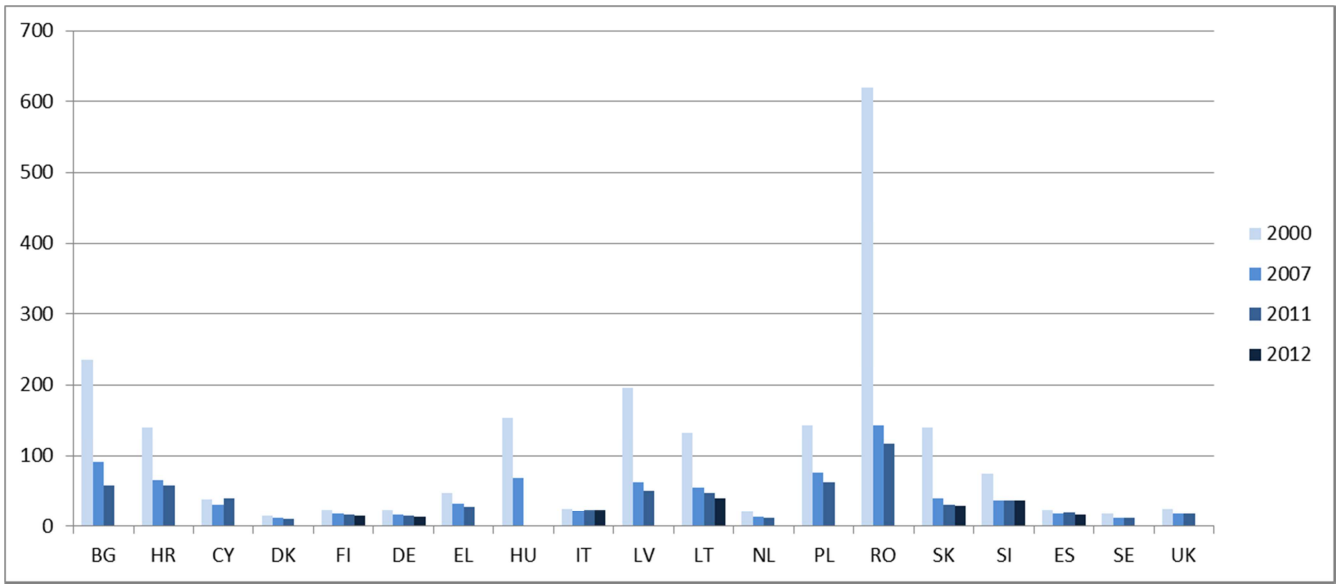
Fig. 39 shows the residential energy per capita normalized by HDD, GDP per capita and square meter per capita for 19 member states. By measuring the residential energy on this way, it seems that there is an annual improvement on energy efficiency from 2000 onwards. Fig. 40 shows the differences between member states. The largest changes have happened in member states that belong to NMS-13 while member states such as Finland, Denmark and Germany rank very low and there has not been as much change from 2000.

Fig. 39 Residential energy per capita, normalized by HDD, GDP per capita, m2 per capita for 19 member states[9] 2000-2010 Data: Eurostat, Odyssee



[9] Excludes AT,BE,CZ,EE,FR,IE,LU,MT and PT due to incomplete data

Fig. 40 Residential energy per capita, normalized by HDD, GDP per capita, m2 per capita for 19 member states Data: Eurostat, Odyssee



Heating Degree Days (HDD)

As mentioned previously, heating degree days are closely related to the heating demand. Changes in the residential heating demand especially in the case of gas consumption can reflect changes in HDD. In 2012, HHD was higher by 5.9% compared to 2000. From 2000 onwards, HDD had higher value than that of 2000 with the exception of only two years: 2007 and 2011. In 2010 there was an exceptionally cold winter and HDD rose by 16% compared to 2000. However the following year the decline was very sudden again and the HDD reached to one of the minimum values for this period. From 2003-2005 HDD were relatively stable. When looking into individual member states there is a large variation in the HDD (

Fig. 42). Malta had only 484 HDD while Finland has 4276 HDD. However when looking into NMS-13 and EU-15, although there are the same variations in time, the HDD in NMS-13 are higher than in EU-15, meaning that heating demand is higher as well (

Fig. 43).

Fig. 41. Heating Degree days EU-28, 2000-2012 Data: Odyssee

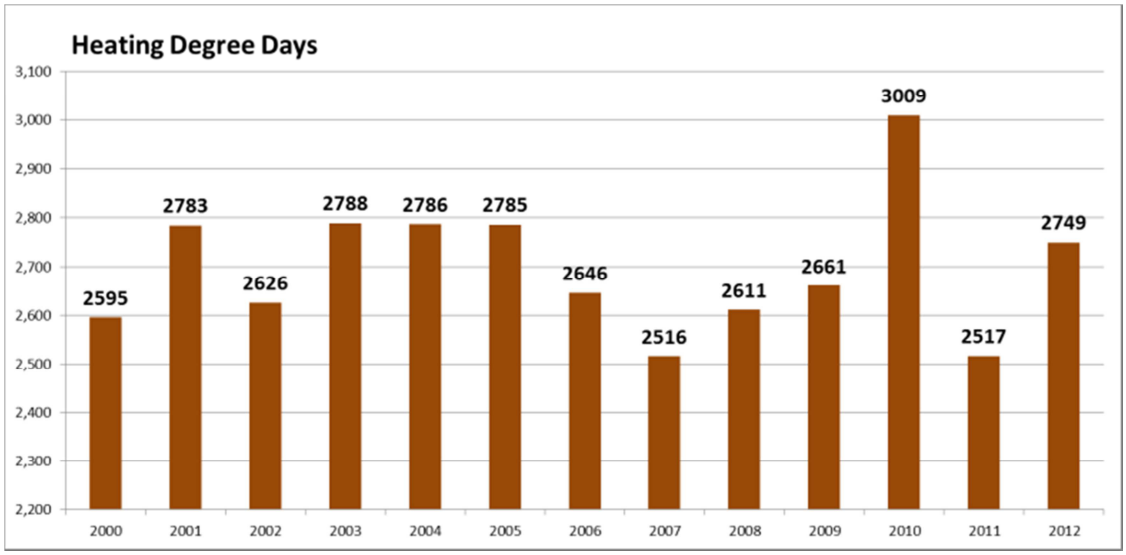


Fig. 42 Average HDD from 2000-2012 for member states. Data: Odyssee

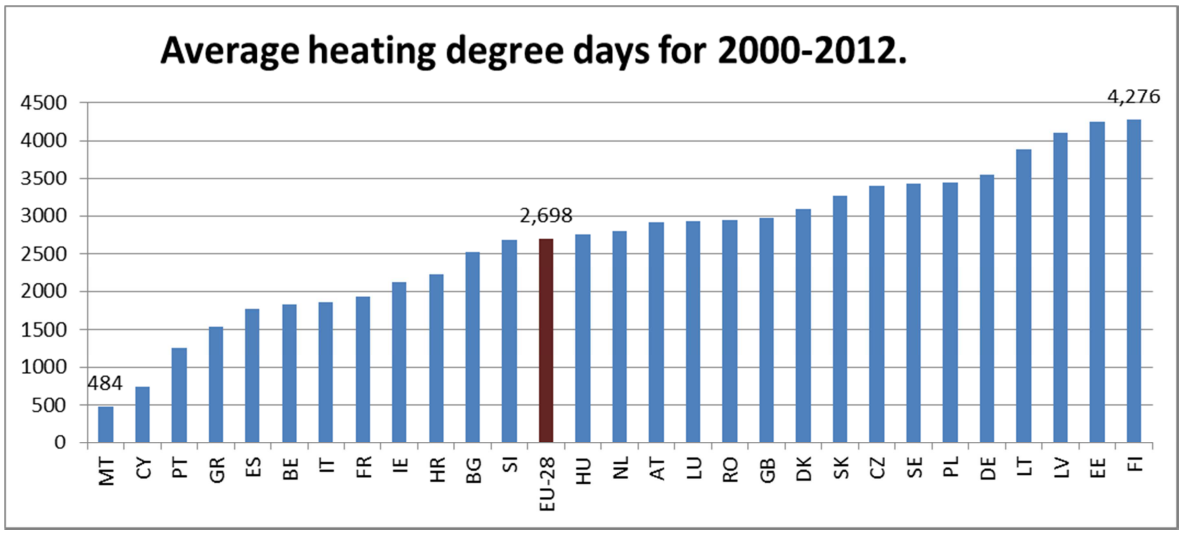
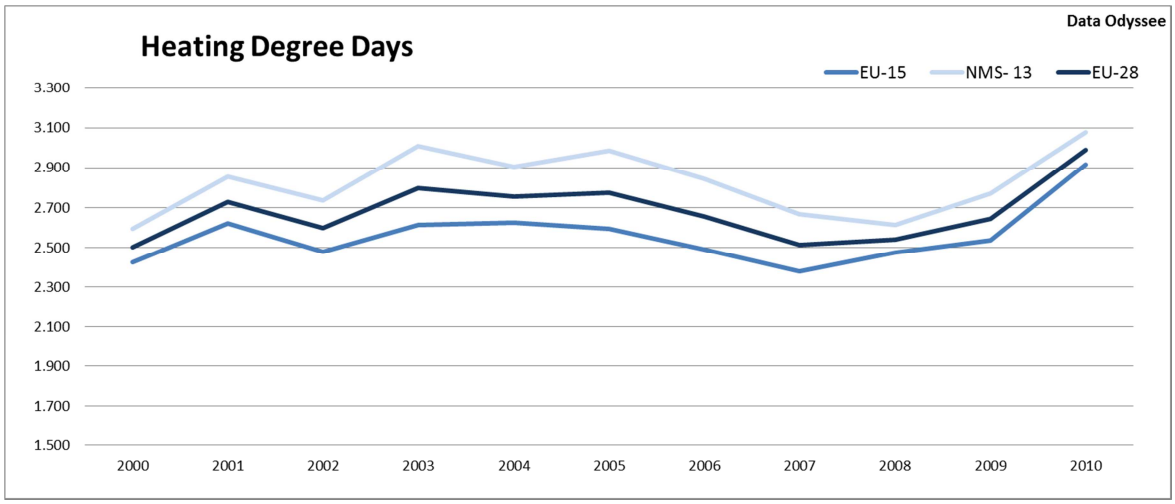


Fig. 43 Heating Degree Days 2000-2011 for EU-28, EU-25, NMS-13. Data Odyssee



To sum up, the developments in EU that lead to an increase of residential energy consumption are: population growth, decrease of average number of people per household and increase of dwelling size. In addition there is an increase of GDP, but the effect on residential consumption is not straightforward. The last years, there has been a decline in the ratio of per capita residential energy consumption to per capita GDP. The variations in the residential energy per dwelling follow closely those of the heating degree days but by a direct comparison of these two variables, it looks that the residential energy consumption of the last years, has declined more compared to the changes in HDD.

2.1 Residential Energy Consumption - Gas

Fig. 44 Gas – Gross consumption, EU-28, Data: Eurostat

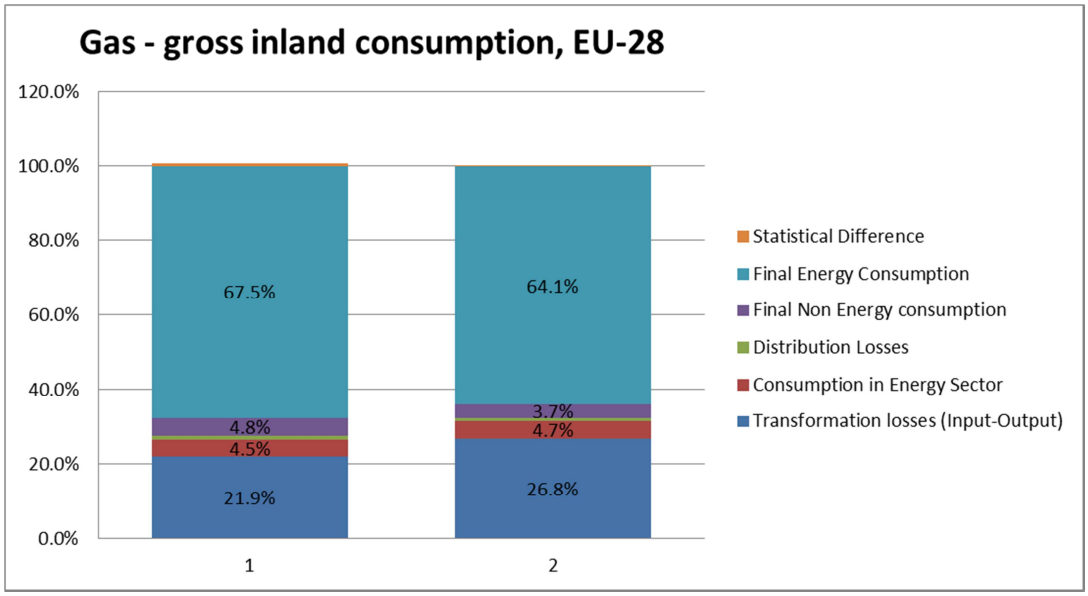
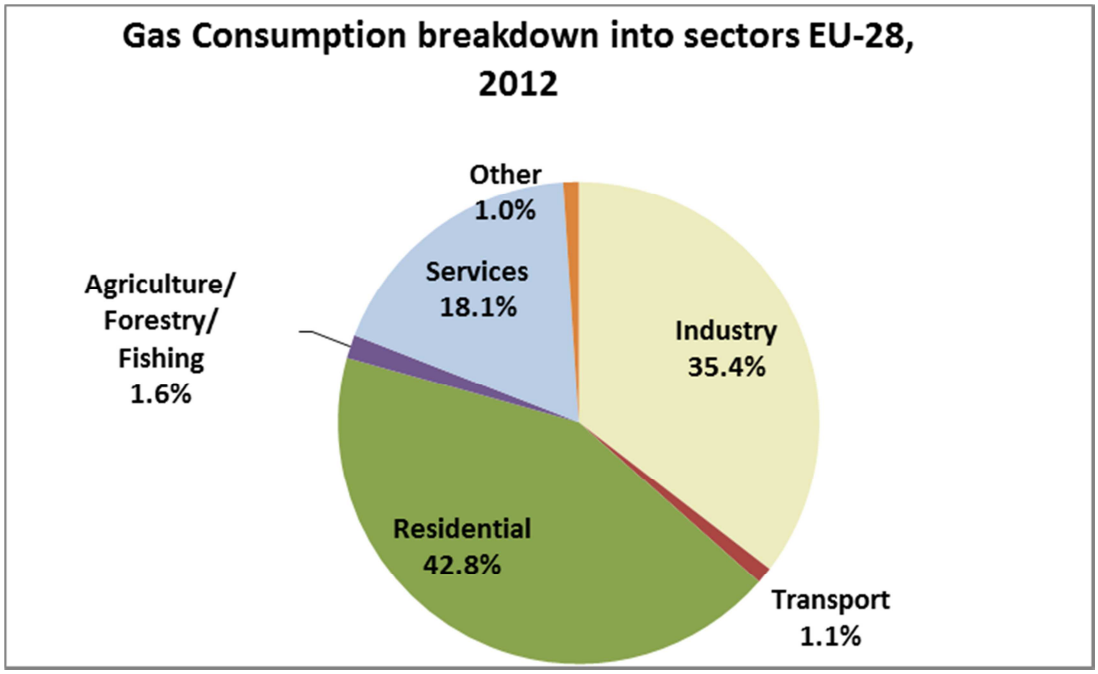


Fig. 45 Final gas consumption breakdown into sectors, Data: Eurostat



Final gas consumption

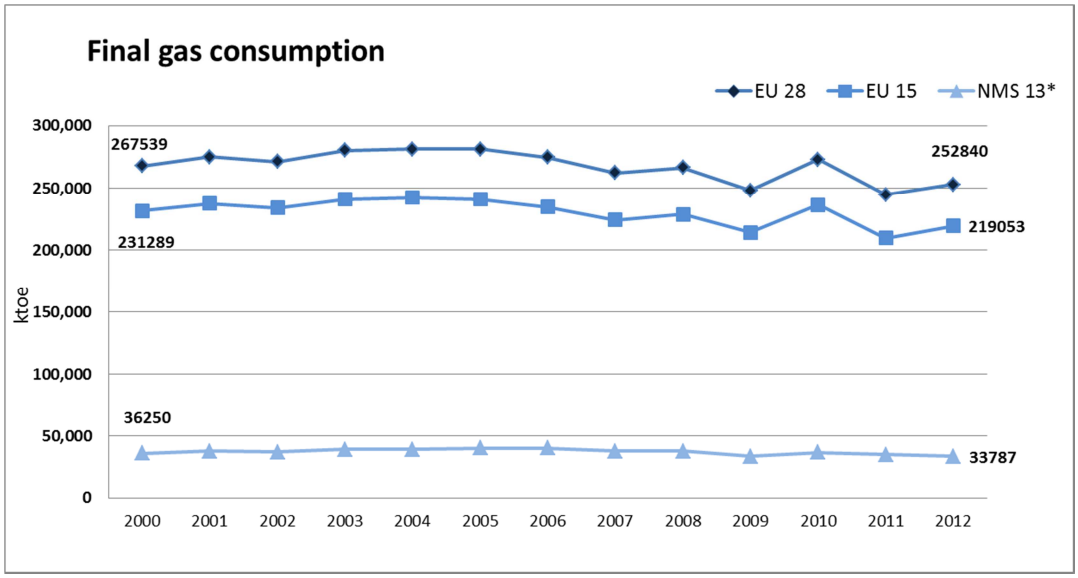
Gas is the main energy supply for the residential sector (42.8%), where it is closely related to heating and hot water demand. Besides the residential sector, it is widely used in industry (35.4%) and less used in the service sector (18.1%). In 2000, final gas consumption in EU-28, was 268 Mtoe and by 2012 it fell to 253 Mtoe, which is -5.5% decline (

Fig. 46). Gas consumption, has been higher compared to the consumption of 2000 for the period of 2000-2006. The peak point for this period was in 2004 with a consumption of 281 Mtoe and 5.2% increase compared to 2000 (Table 5). Then it started to drop. In 2009, consumption reached 248 Mtoe which represented a -7.4% decline compared to 2000. The following year, there was 10.2% growth and consumption reaches approximately the same levels of 2000. This sudden growth can be related to the high number of degree days in 2010, which went up by 13.1% in one year, but also to the economic rebound effects after the crisis in 2009. In 2011, Heating Degree Days (HDD) dropped by -16.4% (similar to the 2007 value), while gas consumption dropped by -10.4%, to 245 Mtoe. In 2012 gas consumption increased again by 3.4% while HDD rose by 9.2%. Therefore compared to 2000, gas consumption in 2012, changed by -5.5% while heating degree days changed by +5.9%. This shows that there is a correlation of heating degree days with final gas consumption, but also that gas consumption has decreased more than what it would be explained by the HDD alone.

In EU-15 the annual changes display a similar pattern. During the period 2000-2012, there has been a decline of 5.3% (Table 5), from 231 Mtoe to 219 Mtoe. Compared to 2000, consumption was higher for the period of 2000-2006, with a peak in 2004, where there was a total growth of 4.6%. After 2007 consumption has been lower than the 2000 levels, with an exemption of 2010 where consumption

was similar to 2000. Similarly, there was large decline in the consumption the years 2009 and 2011 and a peak on 2010. For NMS-13 there has been a total decline of -6.8% for 2000-2012. The period of 2001-2008, consumption was higher than the levels of 2000, reaching a peak on 2006, where it was by 11.6% larger than consumption of 2000. There was large decline in years 2009 and 2011. However the decline in 2011 was almost half than that of 2009, while in EU-15 the decline that took place in 2011 was larger.

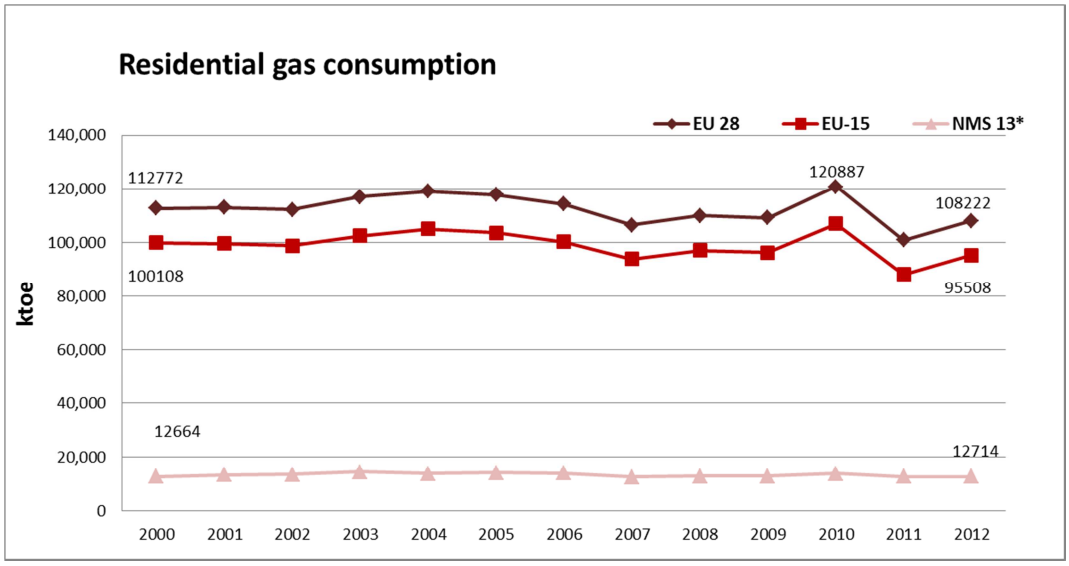
Fig. 46 Final gas consumption in EU-28, EU-15, NMS-13, Data: Eurostat



Residential gas consumption

In the residential sector, gas has undergone a decline of -4%, from 113 Mtoe in 2000 to 108 Mtoe in 2012 (Fig. 47 & Table 5). During the years 2000-2002 consumption was steady. From 2003 there was an increase with a peak on 2004. Then there was a gradual decline with a minimum in 2007. After that there were some variations until 2010, when there was a sudden increase of 10.7% compared to the year before. In 2011 there was a sudden decline and consumption reached a minimum for this period of 101 Mtoe. In 2012 consumption increased as well. More specific, in EU-15 consumption changed by -4.6% during 2000-2012. In 2000 consumption was 100 Mtoe. There were some variations the following years. The most significant changes compared to 2000, happened in 2006 , with a change of -6.1%, in 2010 it grew by +6.9% and the following year by -11.8% compared to 2000. In 2012 consumption was 96 Mtoe. In NMS-13 there was a total growth of 0.4%, from 12,664 to 12,714 ktoe. Despite following the same variations for the years 2000-2012, only in 2007 did the consumption drop below the 2000 levels. In 2011 consumption was larger by 9.2% compared to 2000 but the following years it declined to reach 12,714 ktoe in 2012.

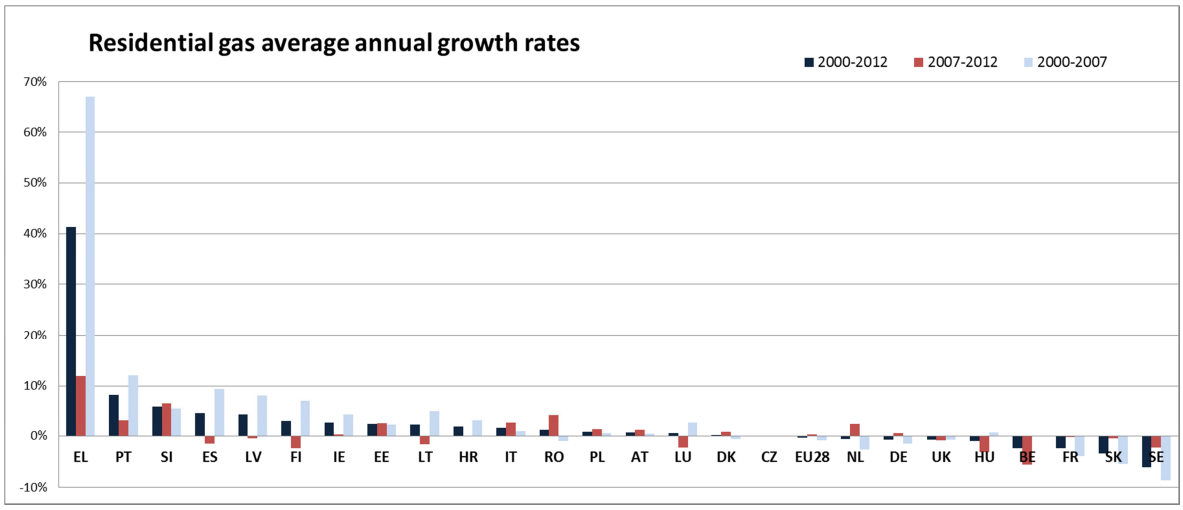
Fig. 47 Residential gas consumption in EU-28, EU-15, NMS-13, Data: Eurostat



Growth trends in member states

In most member states there has been growth in the residential gas consumption. Fig. 49 shows in which member states gas consumption rose and in which it declined on average, for different time periods. In Greece there has been significant growth, followed by Portugal and Slovenia. On the other side in Sweden, Slovakia and France, gas consumption dropped. It is also visible from the graph that the decline took place mostly in the period before 2007. In some member states such as Spain, Latvia, Finland, Luxembourg and Lithuania although gas consumption grew the period 2000-2007, it declined in 2007-2012. In Romania and Netherlands the opposite happened, gas consumption was on decline before 2007 but it rose afterwards.

Fig. 48 Average annual residential gas consumption change over three different time periods. Data: Eurostat.



Residential Gas – Population

Fig. 49 shows the residential gas consumption per capita which changed by -7.4% for the period 2000-2012. The breakdown shows that in EU-15 the decline reached -9.7% while in NMS-13 there was a 4.1% growth, compared to the respective consumptions in 2000. The highest consumption in EU-15 was in 2004 and the minimum in 2011 where there was a -16.5% decline. In NMS-13 the highest consumption was in 2003 with 15.7% growth and the minimum in 2007 where the growth was only 1.3% compared to 2000.

Fig. 49 Residential gas consumption per capita in EU-28, EU-15, NMS-13, Data: Eurostat

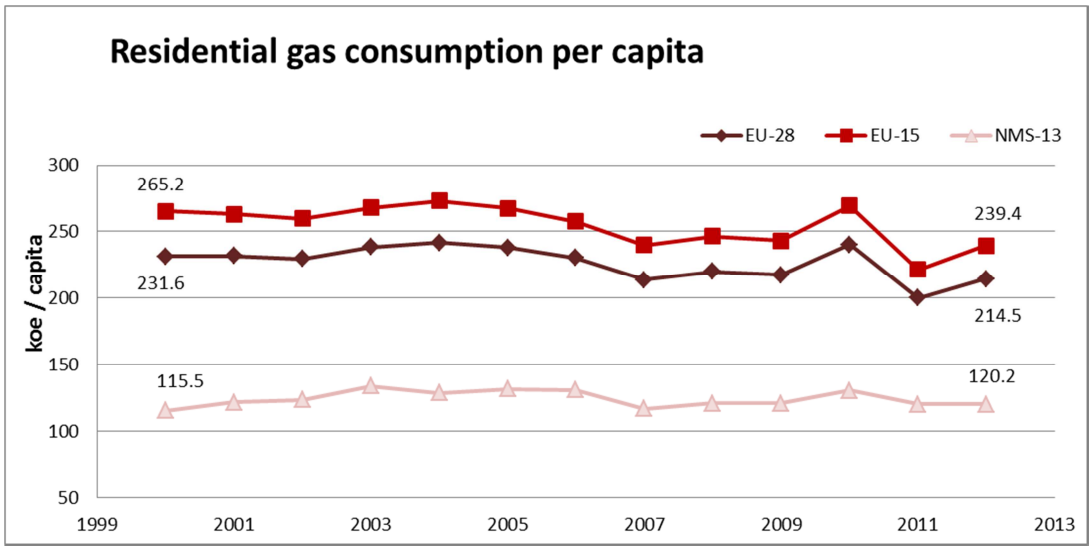


Fig. 50 shows the residential gas consumption per capita divided by the number of heating degree days for each year. Therefore it gives information on how much gas an individual used by correcting for the variations in consumption that are directly related to temperature changes. From 2000-2006 there are some annual variations with the highest point for this period on 2006. However, from 2006–2012, there is a gradual decline. The total change from 2000 until 2012 is -5%.

Fig. 51 shows the variation in different member states. The graph shows that in member states with high gas residential consumption per capita and HDD, there has been decline of this consumption compared

to 2000. Exception to this are Italy and Luxembourg. On the other hand, in member states with low consumption there has small been growth. In Denmark and Poland, besides the low values of consumption, there has been further decline compared to 2000. However it can be seen that the reduction of consumption is much larger than the respective growth in the member states at the left side of the graph. Therefore in total there is decline, as it is shown if Fig. 50.

Fig. 50 Residential gas consumption per capita, divided by HDD, Average EU-28. Data: Eurostat and Odyssee.

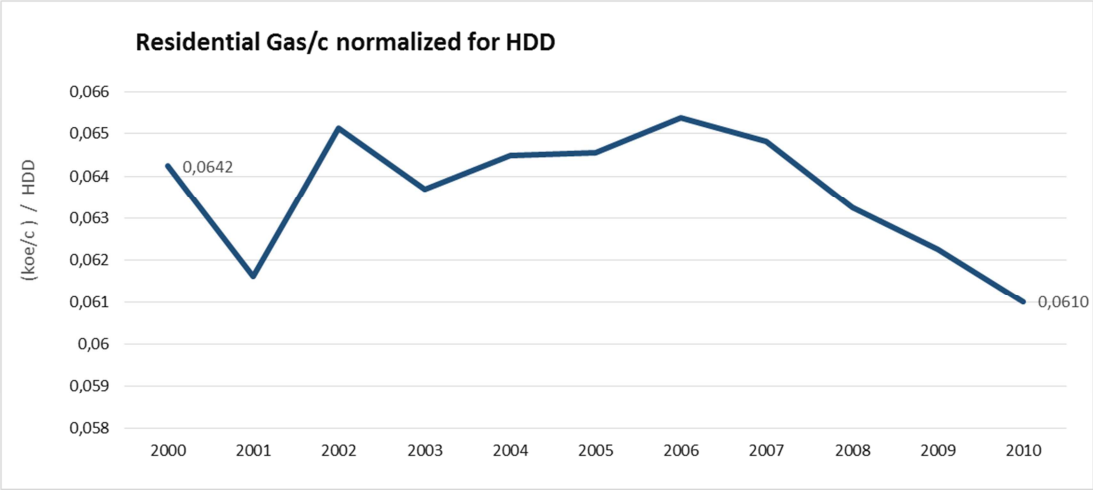
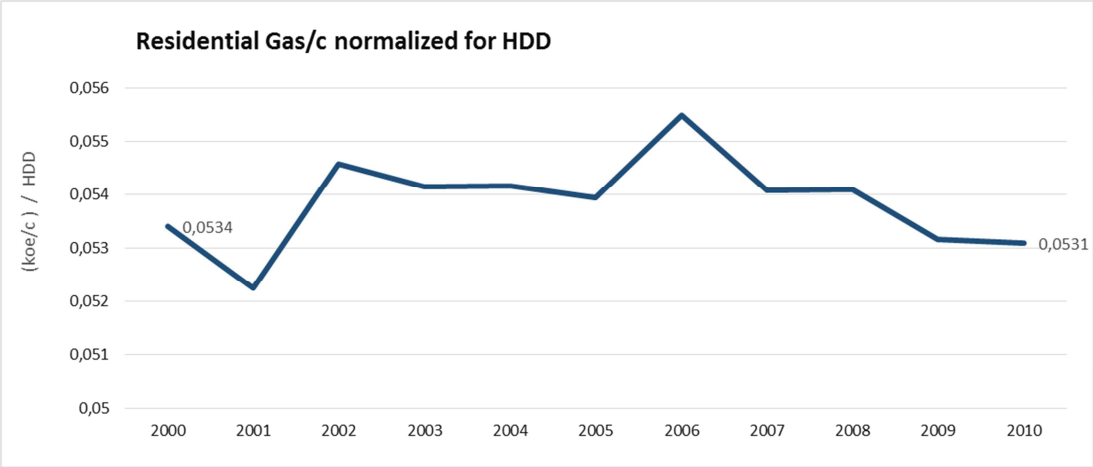
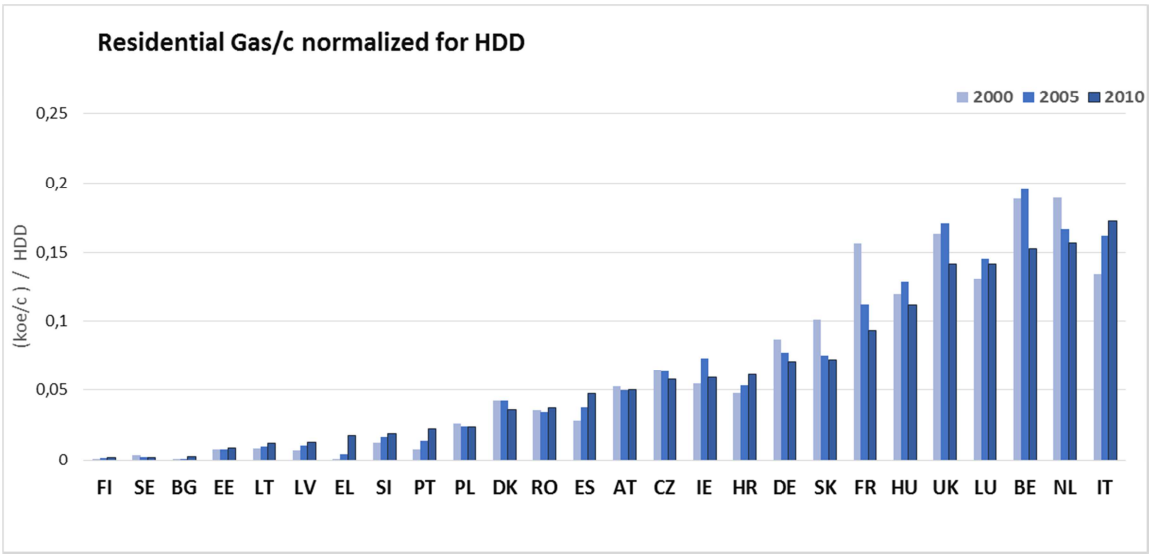


Fig. 50A Residential gas consumption per capita, divided by HDD, Average EU-19[10]. Data: Eurostat and Odyssee.



[10] Excludes AT,BE,CZ,EE,FR,IE,LU,MT and PT due to incomplete data

Fig. 51 Residential gas consumption per capita, divided by HDD for EU-28. Data: Eurostat and Odyssee.



Besides temperature changes, variations in floor area per capita can affect the total residential gas consumption. Fig. 52 takes into account floor area variations as well. Here the decline seems to be more gradual compared to the previous graph, that didn't take into account floor area measurements. However this is also related to the fact that in Fig. 50 there were 28 Member States included. To account for this difference, Fig.50A shows the residential gas consumption for the same member states, with sufficient floor data that were used for Fig. 52 . In total there has been 13% decline from 2000 onwards for Fig. 52. Besides some large variations in 2001 and 2006, the decline seems gradual.

Fig. 53 compares these changes for different member states. Overall the situation seems very similar to the one in

Fig. 51 that did not take into account the floor area. Besides Romania and Croatia where the graphs show that floor area plays some role in the measured residential gas consumption, for the other member states the growth patterns for the different years are similar in both graphs (

Fig. 51 and

Fig. 53).

Fig. 52 Residential gas per capita, per HDD and floor area per capita for 19 Member states with available data[10]. Data: Odyssee, Eurostat

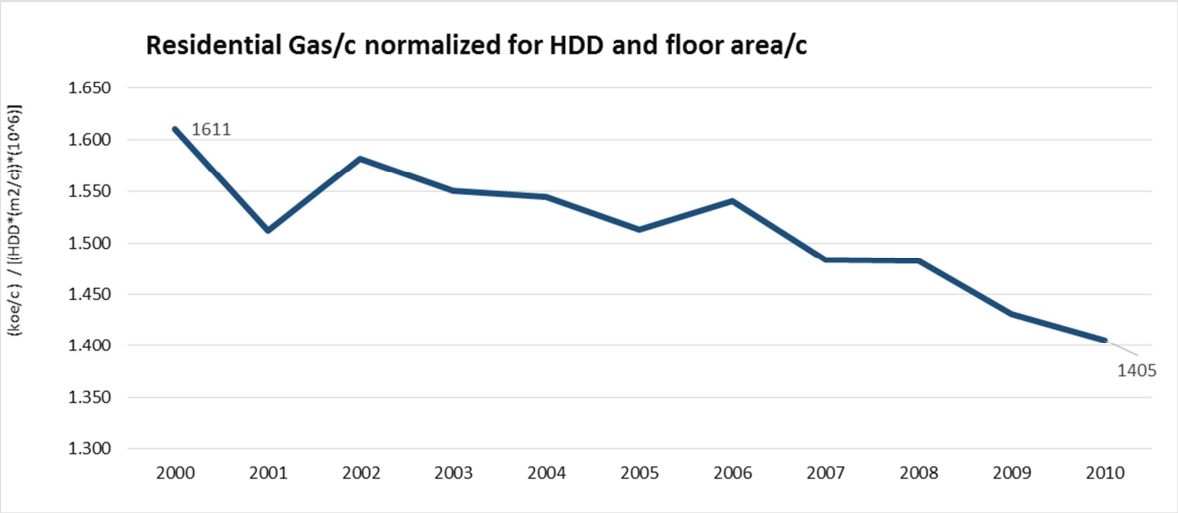
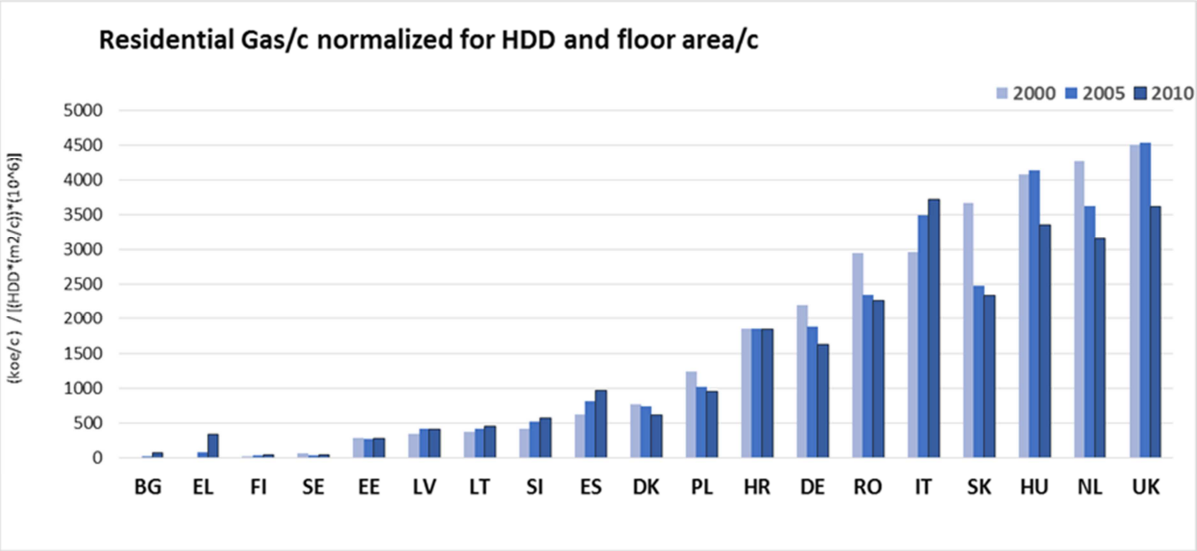


Fig. 53 Residential gas per capita, per HDD and floor area per capita for 19 Member states[10]. Data: Odyssee, Eurostat



Variations in GDP could also affect residential gas consumption. Therefore the results in the previous graphs can be also corrected for GDP per capita. Then it can be seen an even more gradual decline of residential gas consumption, which is now corrected for floor area per capita, HDD and GDP per capita. This is a decline of 62%.

Fig. 54 Residential gas per capita, normalized by HDD and floor area per capita for 19 Member states[9]. Data: Odyssee, Eurostat

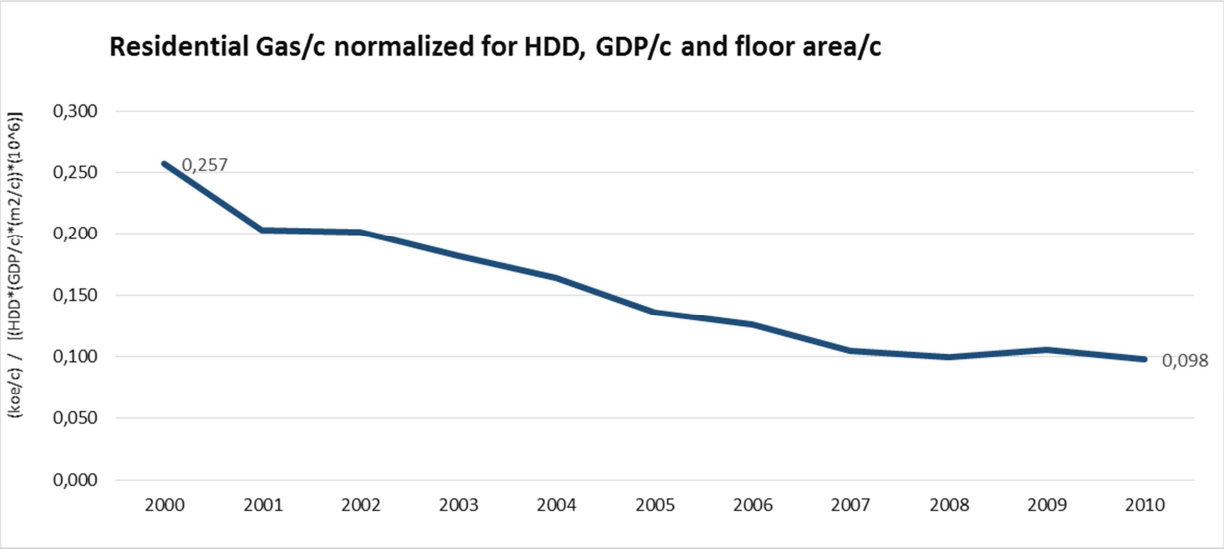


Fig. 55 Residential gas per capita, normalized by HDD and floor area per capita for 19 Member states[9] Odyssee, Eurostat

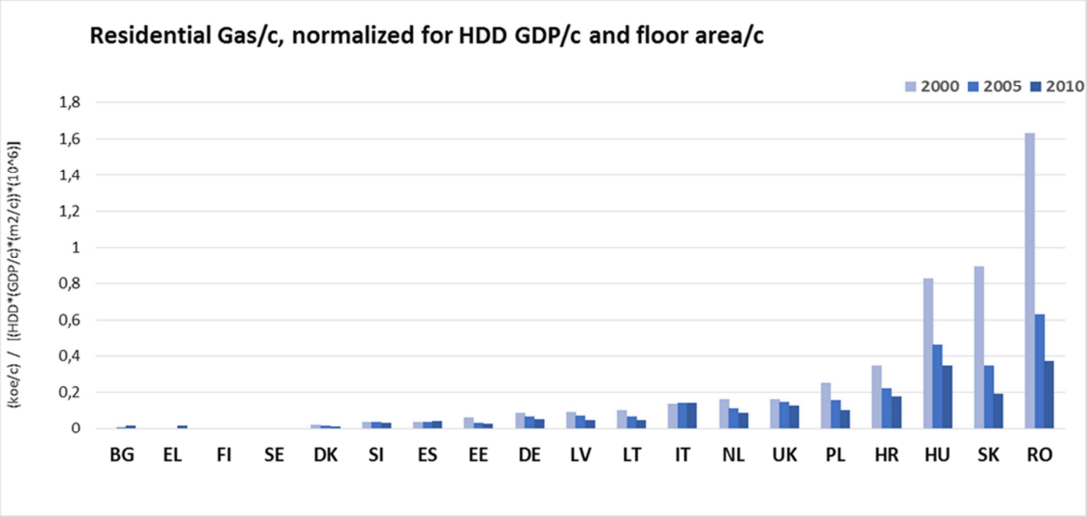


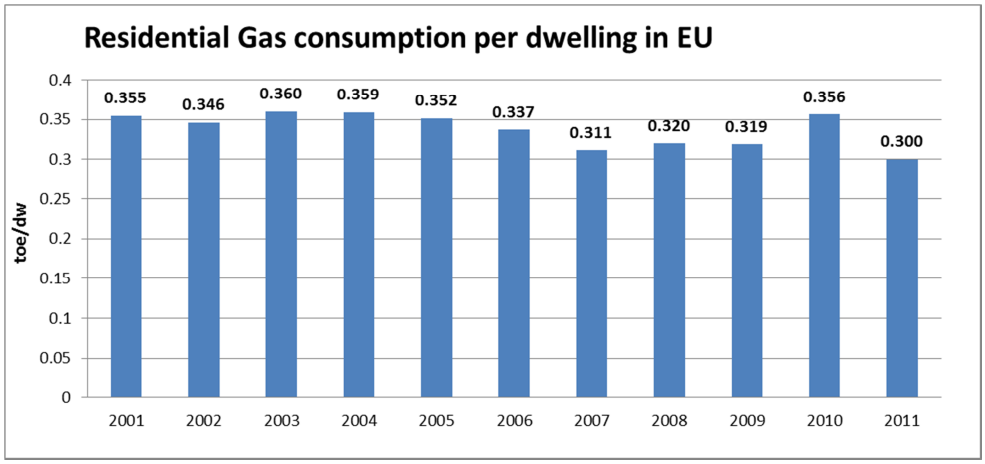
Fig.55 shows the changes for individual member states. It can be seen that there are reductions in all member states. In 2000 Romania, Slovakia and Hungary ranked very high compared to other member states. However by 2010 there is large reduction and eventually the differences between different member states are much smaller. In Italy there seemed to be growth of residential gas consumption, when we did not take into account GDP changes. After adapting for GDP, the consumption is almost the same in 2010 as was in 2000. Croatia on the other hand, seemed to have stable gas consumption in Fig. 54, however after GDP adaptation, it can be seen that gas consumption has declined (Fig.55)

Residential Gas – Dwelling

The correlation between gas consumption and HDD is also visible in the residential gas consumption per dwelling in Fig. 56. In 2001 the average residential gas consumption per dwelling in EU was 0.355 toe. Since then, gas consumption per dwelling on average is decreasing. In 2007 consumption had

declined by 12.3% compared to 2001. In 2010 consumption grew again to reach similar levels with those of 2000. From 2001-2011 the minimum value was for 2011 with a total reduction of 15.6%. Overall, the trend in residential gas consumption per dwelling after 2006 is decreasing.

Fig. 56 Residential Gas consumption per dwelling for 19 EU[11] counties. Data: Eurostat, Odyssee



Comparing residential gas consumption per dwelling across the European Union, substantial differences in consumption levels can be observed. Member states with relatively high per dwelling consumption are the Netherlands and the UK (Fig. 57). In UK, with the exception of 2010, there is a gradual decline which started on 2004 (Fig. 58). UK has implemented many policies on energy efficiency and this decline is possibly the result of these policies. In Netherlands there has been a decline from 2003 onwards, however after 2007 residential gas consumption went up again. Very low consumption levels per dwelling can be found in Bulgaria, Greece, Portugal and Sweden, which do not use gas for heating purposes. Finland, Poland, and Slovenia have big district heating systems for buildings which drive consumption level per dwelling down. Heating with electricity (including heat pumps) is another alternative to gas heating present in these member states. For most of the member states with high consumption levels per dwelling, consumption is lower in 2011 than in 2001.

Fig. 57 Residential Gas consumption per dwelling for EU-19. Data: Eurostat, Odyssee

[11] Incomplete dwelling data for AT, CZ, EE, FR, HU, IE, LU were not used.

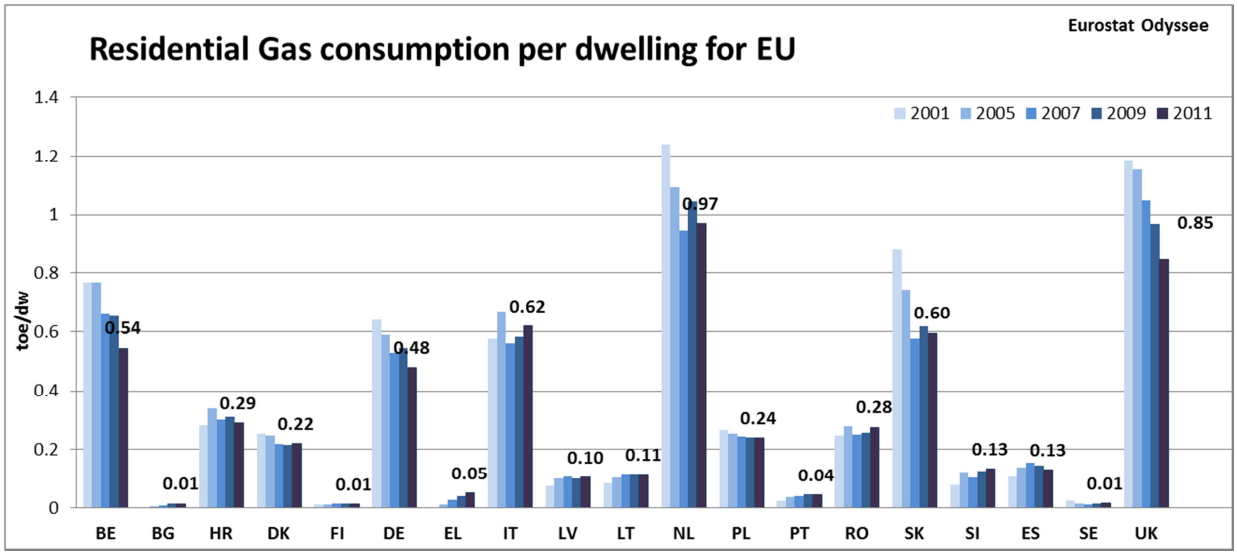


Fig. 58 Residential gas consumption per dwelling, in Netherlands and UK 2000-2011 Data: Eurostat, Odyssee

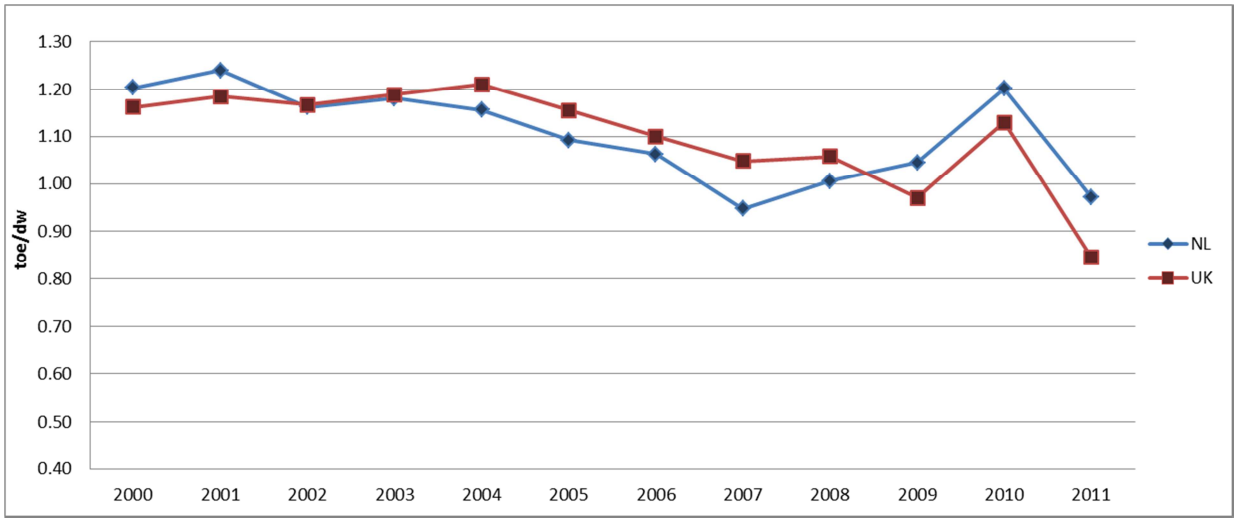
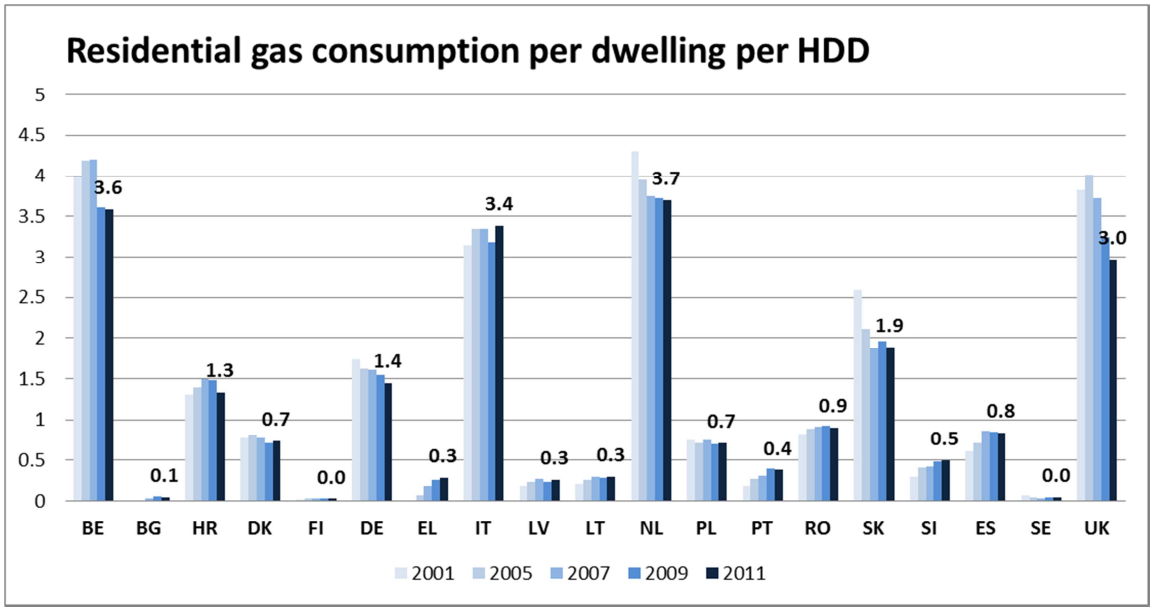


Fig. 59 shows the change of residential gas consumption per dwelling and per heating degree days. While in Fig. 57 Netherlands and UK have the highest gas consumption per dwelling, when taking HDD into account (Fig. 59) Belgium and Italy rank very high as well. In contrast to UK, Netherlands and Belgium, in Italy there has been growth of the residential gas consumption. This is related to decline of oil consumption (Total petroleum products) in favour of gas and renewable energies (Fig. 60). In UK there is large decline which can be seen in both Fig. 57 and Fig. 59. A closer look in the residential energy consumption by all sources shows that the decline is obvious in almost all energy sources, not only gas (

Fig. 61). This is an additional indication of the success of the energy policies that have been implemented the last years in UK.

Fig. 59 Residential gas per dwelling per heating degree days, for different member states. Data: Eurostat, Odyssee



A further comparison of Italy and UK shows that the final residential energy consumption in UK has declined by 6% from 2000 until 2012 while in Italy it grew larger by 25% . The breakdown into gas and electricity consumption (Fig. 63 and

Fig. 64) shows in UK reduction of gas consumption of about 7% while in Italy residential gas consumption grew by 21%. Electricity residential consumption in UK grew only by 3% while in Italy there was growth of 14%.

Fig. 60 Italy, Sources of residential consumption in ktoe, Eurostat

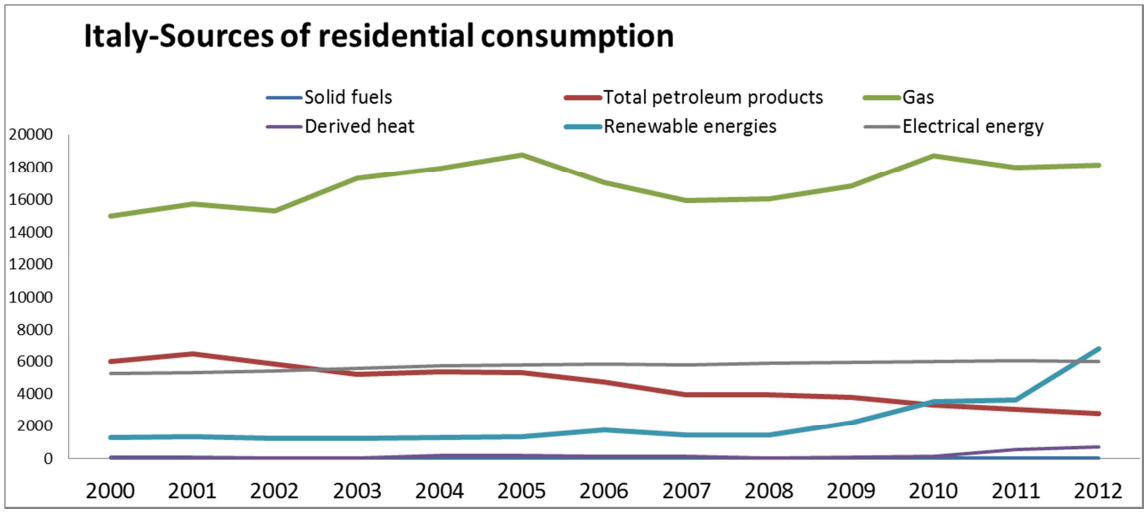


Fig. 61 UK, Sources of residential consumption in ktoe, Eurostat

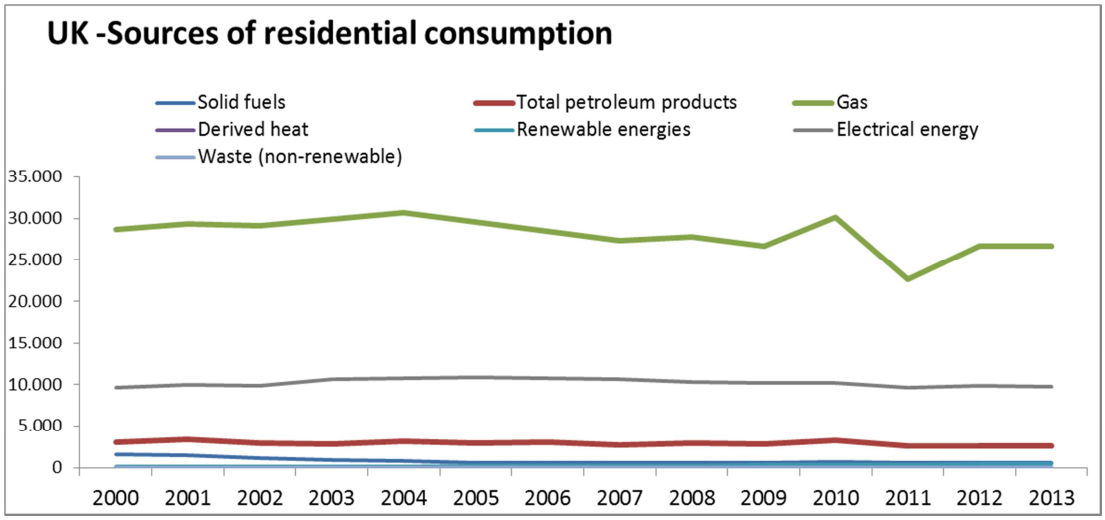


Fig. 62 Italy, UK, final residential energy consumption. Eurostat

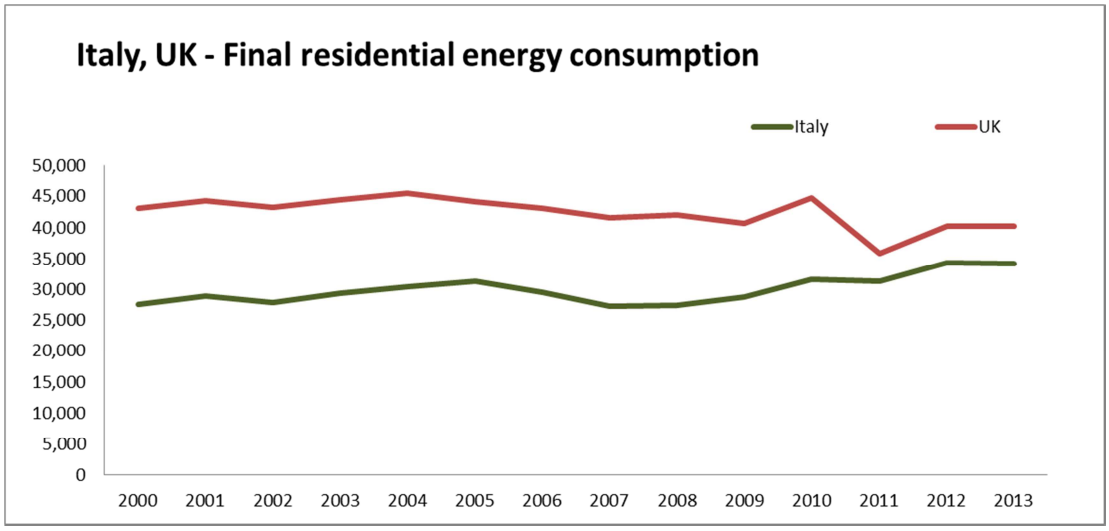


Fig. 63 Comparison of residential gas consumption in Italy and UK, Data Eurostat

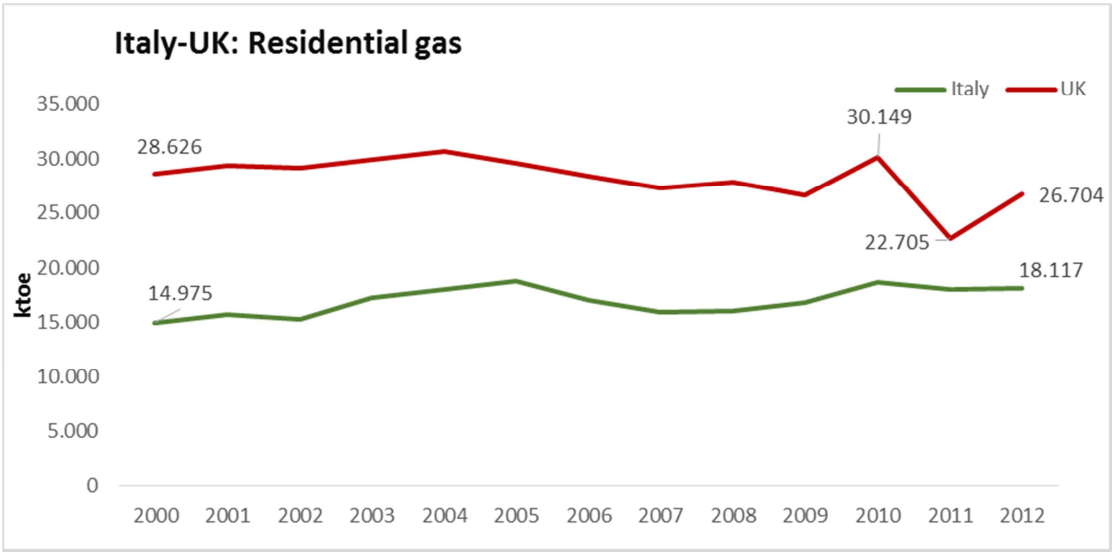
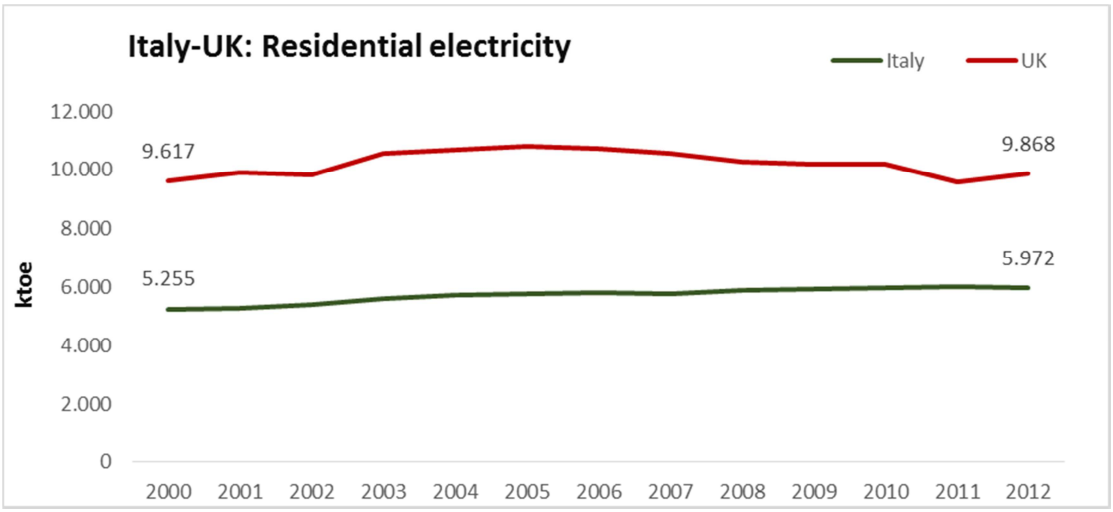
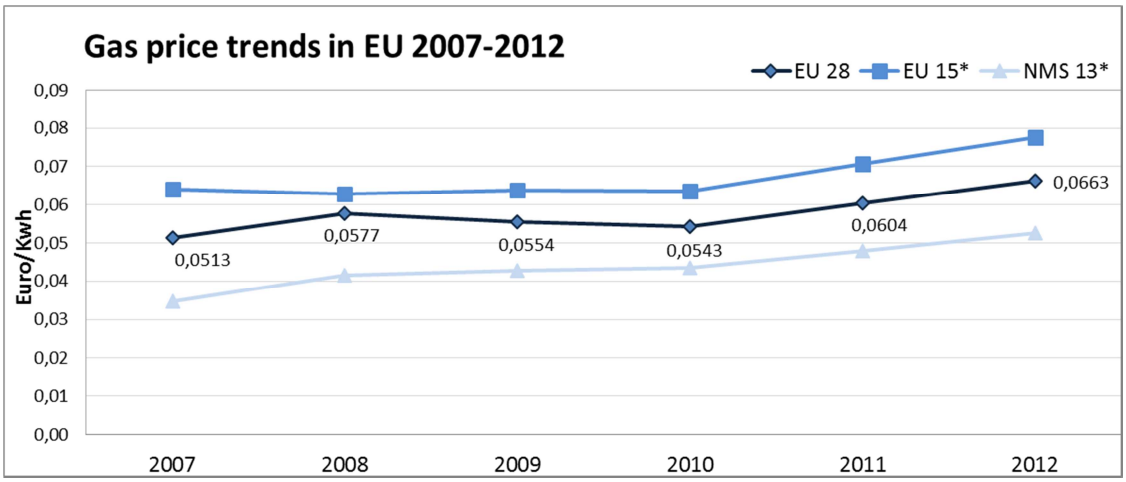


Fig. 64 Comparison of residential electricity consumption in Italy and UK, Data Eurostat



Price trends

Fig. 65 Gas prices for domestic consumers, Band D2 : 20 GJ < Consumption < 200 GJ, All taxes and levies included. Data: Eurostat



Gas prices have been relatively stable from 2007-2010. After 2010 they have increased. Sweden, Denmark and Italy had some of the highest gas prices in 2012, while Croatia, Slovakia and Hungary have some of the lowest prices in EU-28.

Fig. 66 Gas Prices in EU-28, Band D2 : 20 GJ < Consumption < 200 GJ. 2012, Data: Eurostat.

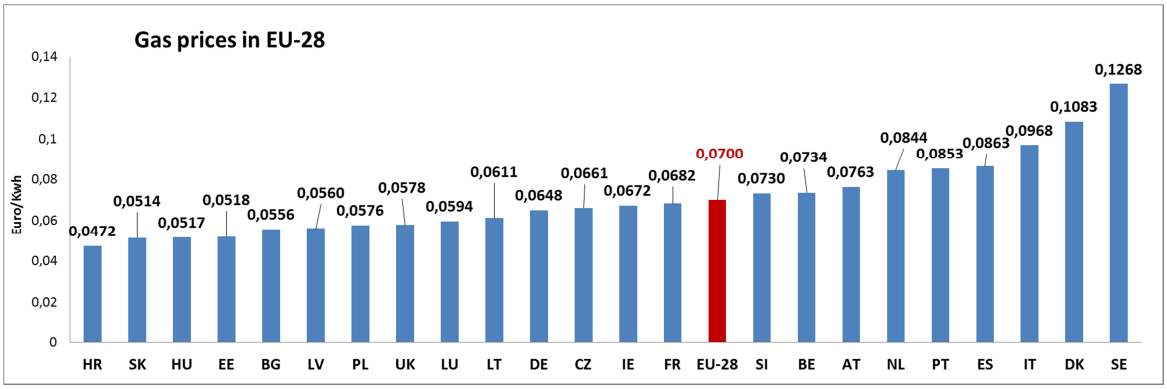


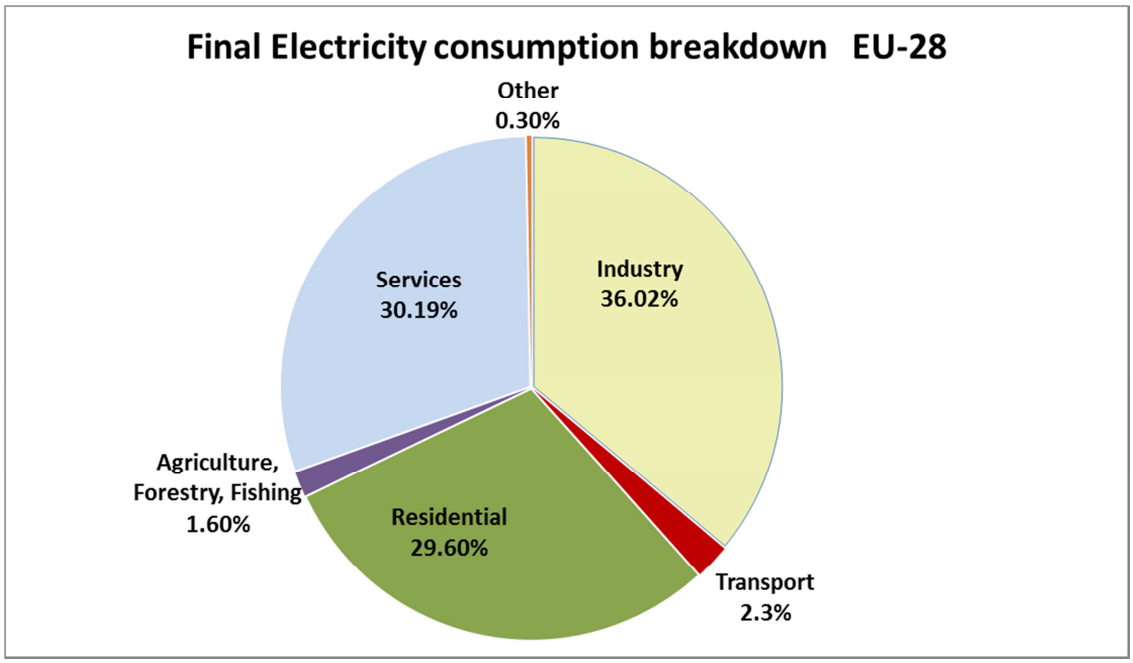
Table 5 Gas consumption. Annual changes compared to 2000.Data: Eurostat

% compared to 2000					Final Gas Consumption (ktoe)								
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	267539	275155	271060	280300	281332	281230	274780	262252	266465	247838	273022	244611	252840
% EU 28		2,8%	1,3%	4,8%	5,2%	5,1%	2,7%	-2,0%	-0,4%	-7,4%	2,0%	-8,6%	-5,5%
% EU 15		2,6%	1,0%	4,1%	4,6%	4,1%	1,3%	-3,1%	-1,2%	-7,5%	2,1%	-9,4%	-5,3%
% NMS 13*		4,7%	3,2%	8,8%	8,7%	11,4%	11,6%	5,2%	4,6%	-6,4%	1,9%	-3,3%	-6,8%
					Residential Gas Consumption (ktoe)								
EU-28	112772	113065	112337	117083	119047	117792	114365	106507	110112	109211	120887	101052	108222
% EU 28		0,3%	-0,4%	3,8%	5,6%	4,5%	1,4%	-5,6%	-2,4%	-3,2%	7,2%	-10,4%	-4,0%
% EU 15		-0,3%	-1,2%	2,5%	5,1%	3,5%	0,2%	-6,1%	-2,8%	-3,7%	6,9%	-11,8%	-4,6%
% NMS 13*		4,8%	5,7%	13,9%	9,4%	11,7%	10,6%	-1,3%	1,5%	1,4%	9,2%	0,5%	0,4%
					Residential Gas Consumption per capita (koe)								
EU-28	232	232	230	239	242	238	230	214	220	217	240	200	214
% EU 28		0,0%	-0,8%	3,0%	4,3%	2,8%	-0,6%	-7,7%	-5,0%	-6,1%	3,7%	-13,6%	-7,4%
% EU 15		-0,7%	-2,1%	1,0%	3,0%	0,8%	-2,9%	-9,5%	-7,0%	-8,3%	1,5%	-16,5%	-9,7%
% NMS 13*		5,2%	7,0%	15,7%	11,4%	14,0%	13,2%	1,3%	4,7%	4,8%	13,0%	4,0%	4,1%
					Gas consumption per dwelling toe/dw								
EU-19*		0,355	0,3463	0,3604	0,3592	0,3516	0,337	0,3113	0,3199	0,3187	0,3563	0,2997	
% EU 19*			-2,4%	1,5%	1,2%	-1,0%	-5,1%	-12,3%	-9,9%	-10,2%	0,4%	-15,6%	
					Heating Degree Days								
EU-28	2595	2783	2626	2788	2786	2785	2646	2516	2611	2661	3009	2517	2749
% EU 28		7,2%	1,2%	7,4%	7,3%	7,3%	2,0%	-3,1%	0,6%	2,5%	15,9%	-3,0%	5,9%
					Gas prices								
EU-28								0,051	0,058	0,055	0,054	0,060	0,066
% EU 28									12,5%	8,0%	5,8%	17,7%	29,1%
% EU 15									-2,1%	-0,7%	-0,8%	10,1%	21,0%
% NMS 13*									19,5%	23,5%	25,4%	38,3%	51,8%

2.2 Residential Energy Consumption - Electricity

In 2012, the residential sector used 30.2% of the total electricity consumption, industry used 36% and the tertiary sector 29.6%. In the residential sector the share of electricity over other energy sources, has become more important as it grew from 21% in 2000 to 24.6% in 2012 (Fig. 12). Electricity consumption is related to household appliances, lighting, water heating, equipment and there are efforts to promote energy efficiency in the sector.

Fig. 67 Breakdown into sectors of electricity consumption in EU-28, Data: Eurostat.



Final electricity consumption

Final Electricity Consumption was 2531 TWh in 2000 and increased to 2798 TWh by 2012. That is an increase of 10.6% (Table 6). From the 2798 TWh of electricity consumption, the majority, 2435 TWh are consumed in EU-15 and only 13% (363 TWh) is consumed in NMS-13. From 2000 to 2008 electricity consumption had been on the rise (

Fig. 68). By 2008 consumption had increased a total of 13.2% in EU-28 and was 2867 TWh. In both EU-15 and NMS-13 electricity consumption was increasing the period 2000 – 2008. Whereas the total electricity consumption was increasing the growth rate has been declining especially for EU-15 (Fig. 69). Moreover, in 2009 there was a significant electricity consumption decline which can be related to the financial and economic crisis. In 2010 electricity consumption increased equally for EU-15 and NMS-13 and it almost reached the same consumption levels of 2008. In 2011, consumption declined by 2% in EU-28, while the following year there was a slight increase of 0.3%. The pattern of changes was slightly different for NMS-13. In contrast to EU-15, in 2011 there was still growth, while in 2012 there was decline. In total from 2000 - 2012, final electricity consumption grew by 21% in NMS-13 and by 9% in EU-15 (Table 6).

Fig. 68 Final electricity consumption 2000-2012, in EU-28, EU-15, NMS-13, Data: Eurostat.

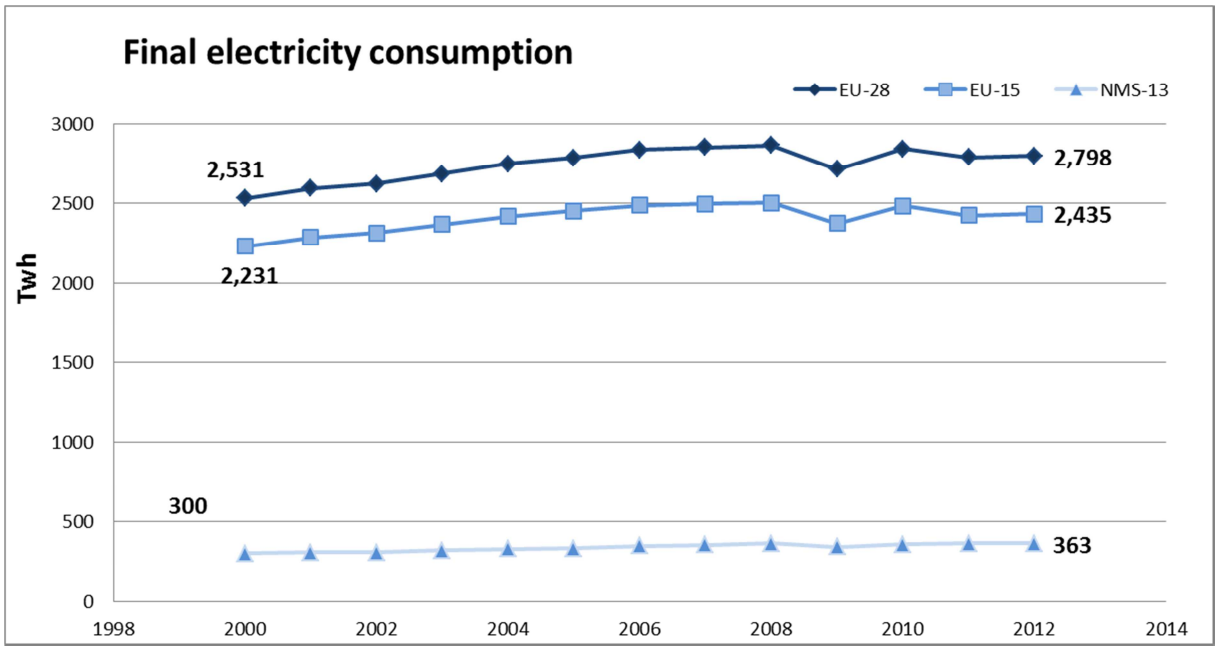
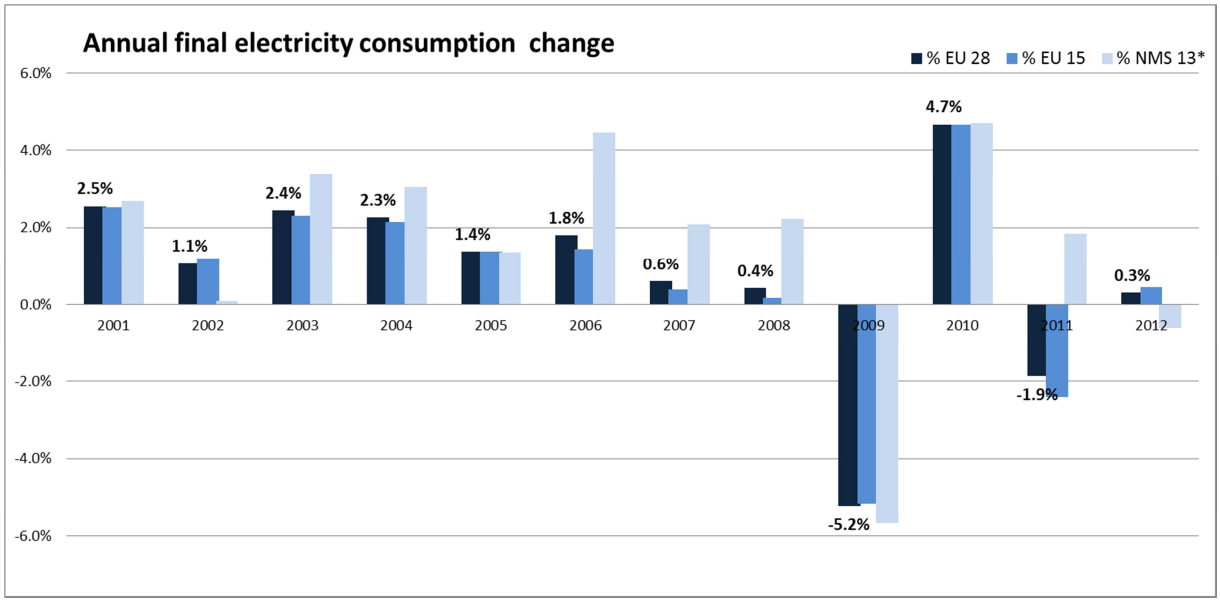
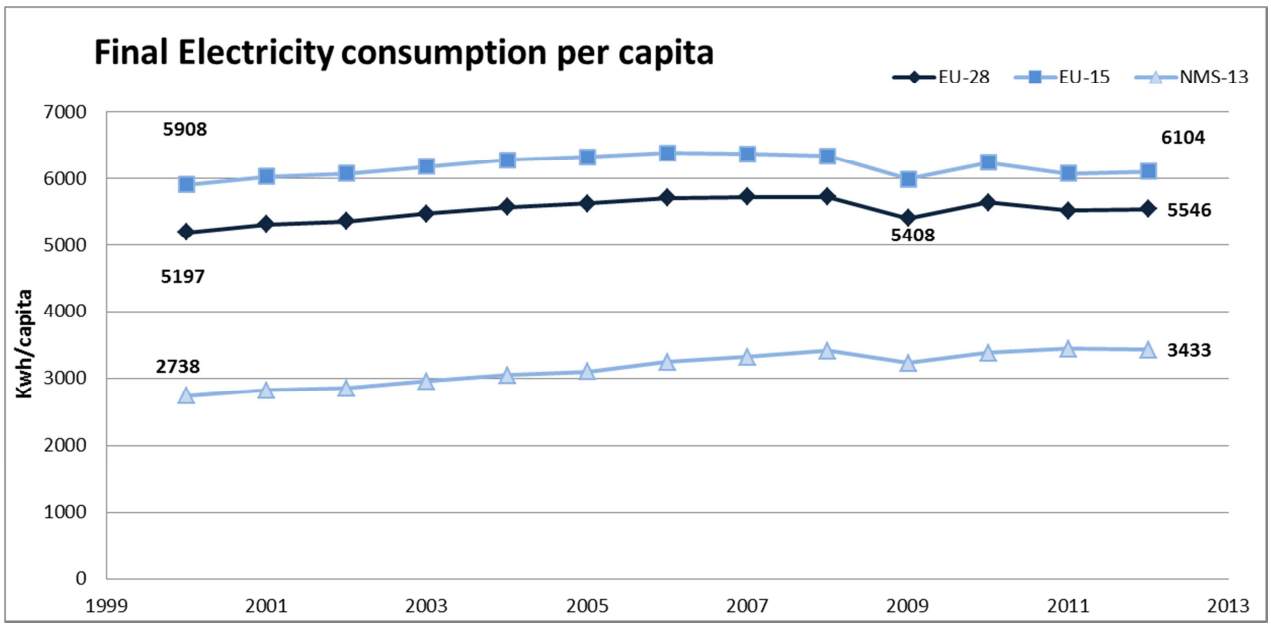


Fig. 69 Annual change of final electricity consumption, Data: Eurostat



Final electricity per capita was 5546 KWh in 2012 (Fig. 70). Electricity consumption per capita shows the same patterns of change with final electricity consumption. There was growth between 2000 and 2008. In 2009 there was decline and then subsequent growth to the previous levels. However, the per capita growth of consumption in EU-28 for 2000-2012 is 6.7% instead of 10.6%. The breakdown into EU-15 and NMS-13, shows that in EU-15 growth is 3.3% (instead of 9.2% for final electricity consumption), while in NMS-13 growth has been even higher at 25.4% when final electricity consumption was 21%. Therefore by taking the population into account, it can be seen that electricity consumption growth was much higher in NMS-13.

Fig. 70 Per capita final electricity consumption. Data: Eurostat



Residential electricity consumption

About 30% of the final electricity consumption is used in the residential sector. Residential electricity consumption grew by 15% from 720,049 GWh in 2000 to 828,343 GWh in 2012. While final electricity consumption dropped in 2009 and 2011, residential electricity dropped slightly in 2007 and then more on 2011 (Fig. 69, Fig. 72). In 2007 the annual decline was only -1% while in 2011 was -5% (Fig. 72). Both reductions can be related to the low heating degree days as approximately 19% of residential electricity is used for heating systems and electric boilers. Heating degree days had annual drops of 5% in 2007 and by 19% in 2011 (Table 5). In EU-15 the total growth was 14.2% while in NMS-13 growth was 21.3% (Table 6). In both cases there are similar annual changes. From 2009 onwards the annual changes in NMS-13 are less pronounced compared to EU-15.

Fig. 71 Residential electricity consumption 2000-2012 Data:Eurostat

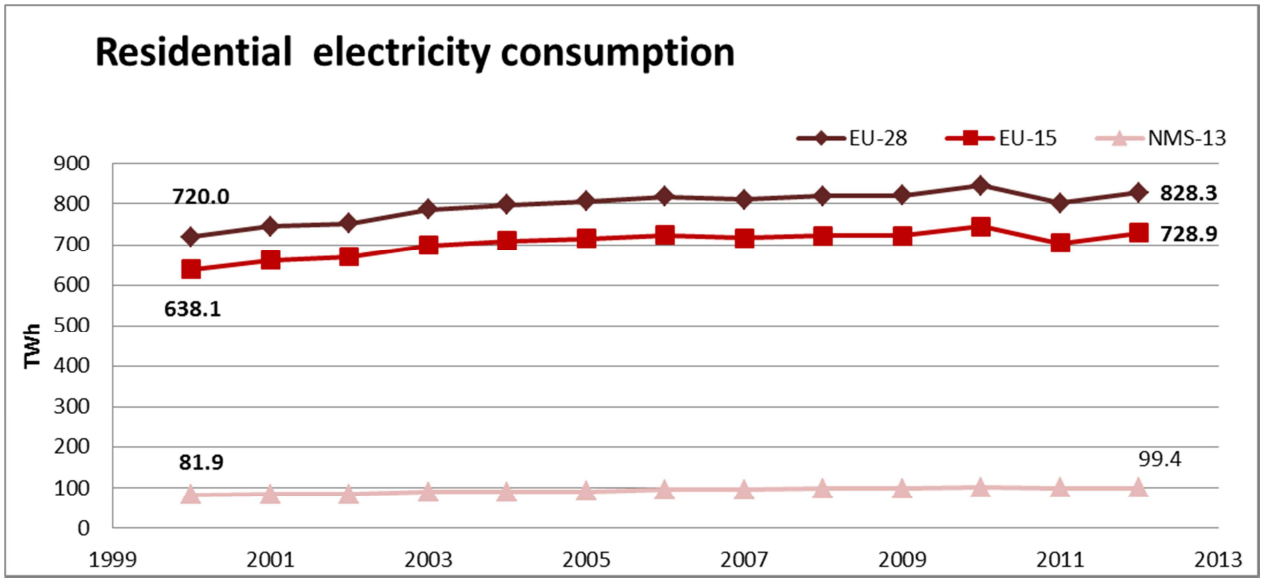
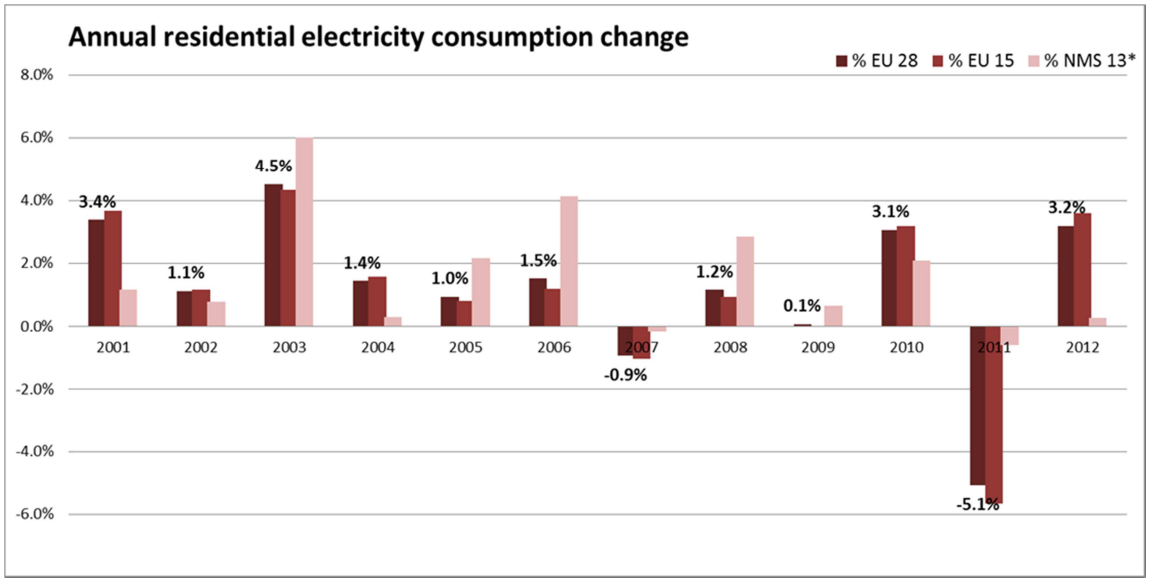


Fig. 72 Annual changes of residential electricity consumption. Data:Eurostat



In total, there have been similar annual changes in the residential and final electricity consumption from 2000 onwards. Some differences exist in 2007 and 2009. In 2007 there was 0.9% reduction in residential consumption, but a 0.6% growth in final electricity consumption. This could be attributed to the decline in the heating degree days. In 2009 there was 0.1% growth in residential consumption and a 5.2% reduction in final electricity. This is probably related to the economic crisis, which could have resulted in a reduction of the electricity demand from other sectors, such as industry or services.

Growth trends in Member States

Between 2000 and 2012 the EU Member States with overall negative growth rates in residential electricity consumption were Belgium, Slovakia, Sweden, and Denmark. The member states with the highest growth rates are Spain Cyprus, Romania and Latvia (Fig 73). However, most of the growth in these countries took place before 2007. In Slovakia and Bulgaria there was on average reduction of the residential electricity consumption from 2000- 2007 while for the period 2007-2012 there was growth. In contrast, in Malta, Hungary, UK and Portugal, despite some growth before 2007, after 2007 there was on average decline.

Fig. 73 Average annual growth rates over three different time periods Data: Eurostat

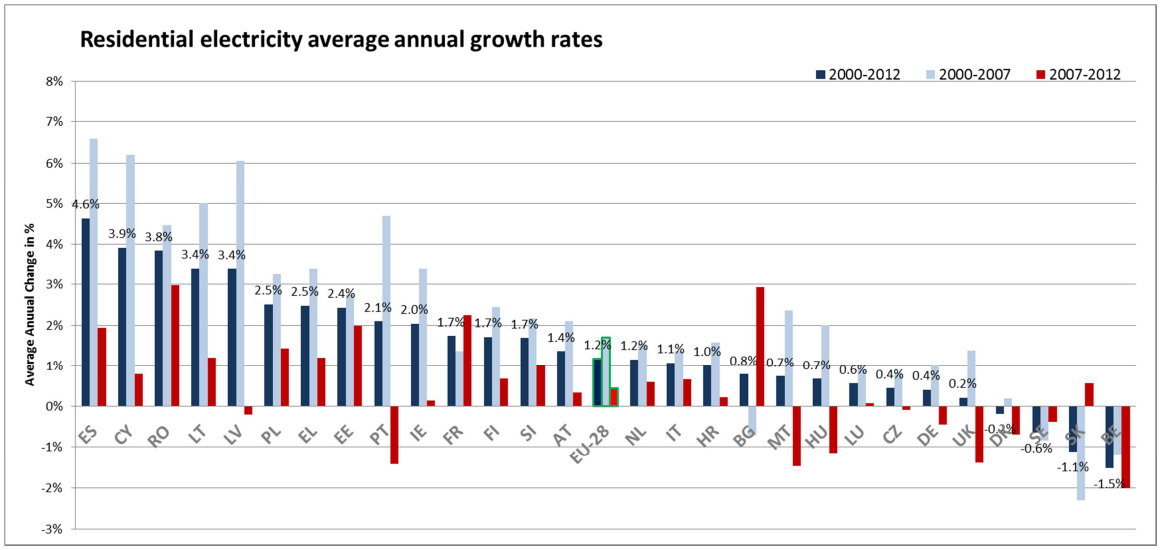


Table 6 Electricity consumption changes compared to 2000, Data: Eurostat

% compared to 2000	Final Electricity Consumption (Twh)												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	2530.79	2595.31	2623.12	2687.07	2747.75	2785.74	2836.10	2853.28	2865.60	2716.05	2842.78	2789.75	2798.28
EU-15	2230.52	2286.96	2314.47	2368.01	2418.97	2452.45	2487.94	2497.86	2502.27	2373.34	2483.97	2424.30	2435.08
NMS-13	300.27	308.35	308.65	319.06	328.78	333.29	348.17	355.41	363.34	342.71	358.81	365.45	363.20
% EU 28		2.5%	3.6%	6.2%	8.6%	10.1%	12.1%	12.7%	13.2%	7.3%	12.3%	10.2%	10.6%
% EU 15		2.5%	3.8%	6.2%	8.4%	9.9%	11.5%	12.0%	12.2%	6.4%	11.4%	8.7%	9.2%
% NMS 13*		2.7%	2.8%	6.3%	9.5%	11.0%	15.9%	18.4%	21.0%	14.1%	19.5%	21.7%	21.0%
	Residential Electricity Consumption (Gwh)												
EU-28	720049	744491	752791	786842	798178	805762	817983	810222	819598	820266	845457	802670	828343
EU-15	638106	661590	669240	698267	709325	715000	723475	715855	722535	722559	745720	703529	728916
NMS-13	81943	82901	83551	88575	88853	90762	94508	94367	97063	97707	99737	99141	99427
% EU 28		3.4%	4.5%	9.3%	10.9%	11.9%	13.6%	12.5%	13.8%	13.9%	17.4%	11.5%	15.0%
% EU 15		3.7%	4.9%	9.4%	11.2%	12.1%	13.4%	12.2%	13.2%	13.2%	16.9%	10.3%	14.2%
% NMS 13*		1.2%	2.0%	8.1%	8.4%	10.8%	15.3%	15.2%	18.5%	19.2%	21.7%	21.0%	21.3%
	Final Electricity Consumption per Capita (Kwh)												
EU-28	5197	5317	5364	5475	5577	5630	5711	5725	5726	5408	5647	5525	5546
EU-15	5908	6032	6075	6181	6278	6327	6384	6376	6346	5990	6247	6074	6104
NMS-13	2738	2822	2850	2956	3054	3103	3250	3327	3419	3230	3387	3447	3433
% EU 28		2.3%	3.2%	5.3%	7.3%	8.3%	9.9%	10.2%	10.2%	4.1%	8.7%	6.3%	6.7%
% EU 15		2.1%	2.8%	4.6%	6.3%	7.1%	8.1%	7.9%	7.4%	1.4%	5.7%	2.8%	3.3%
% NMS 13*		3.1%	4.1%	8.0%	11.5%	13.3%	18.7%	21.5%	24.8%	17.9%	23.7%	25.9%	25.4%
	Residential Electricity Consumption per Capita (Kwh)												
EU-28	1479	1525	1539	1603	1620	1629	1647	1626	1638	1633	1680	1590	1642
EU-15	1690	1745	1757	1823	1841	1845	1856	1827	1832	1824	1876	1763	1827
NMS-13	747	759	772	821	825	845	882	883	913	921	942	935	940
% EU 28		3.1%	4.1%	8.4%	9.6%	10.1%	11.4%	9.9%	10.8%	10.5%	13.6%	7.5%	11.0%
% EU 15		3.2%	3.9%	7.8%	8.9%	9.1%	9.8%	8.1%	8.4%	7.9%	11.0%	4.3%	8.1%
% NMS 13*		1.5%	3.3%	9.8%	10.4%	13.1%	18.0%	18.2%	22.2%	23.2%	26.0%	25.1%	25.8%
	Electricity prices												
EU-28										0.1636	0.1700	0.1820	0.1917
% EU 28											3.9%	11.2%	17.2%

Table 7 Electricity consumption annual changes, Data: Eurostat

% Annual changes	Final Electricity Consumption (Twh)												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	2531	2595	2623	2687	2748	2786	2836	2853	2866	2716	2843	2790	2798
EU-15	2231	2287	2314	2368	2419	2452	2488	2498	2502	2373	2484	2424	2435
NMS-13	300	308	309	319	329	333	348	355	363	343	359	365	363
% EU 28		2.5%	1.1%	2.4%	2.3%	1.4%	1.8%	0.6%	0.4%	-5.2%	4.7%	-1.9%	0.3%
% EU 15		2.5%	1.2%	2.3%	2.2%	1.4%	1.4%	0.4%	0.2%	-5.2%	4.7%	-2.4%	0.4%
% NMS 13*		2.7%	0.1%	3.4%	3.0%	1.4%	4.5%	2.1%	2.2%	-5.7%	4.7%	1.9%	-0.6%
	Residential Electricity Consumption (Gwh)												
EU-28	720049	744491	752791	786842	798178	805762	817983	810222	819598	820266	845457	802670	828343
EU-15	638106	661590	669240	698267	709325	715000	723475	715855	722535	722559	745720	703529	728916
NMS-13	81943	82901	83551	88575	88853	90762	94508	94367	97063	97707	99737	99141	99427
% EU 28		3.4%	1.1%	4.5%	1.4%	1.0%	1.5%	-0.9%	1.2%	0.1%	3.1%	-5.1%	3.2%
% EU 15		3.7%	1.2%	4.3%	1.6%	0.8%	1.2%	-1.1%	0.9%	0.0%	3.2%	-5.7%	3.6%
% NMS 13*		1.2%	0.8%	6.0%	0.3%	2.1%	4.1%	-0.1%	2.9%	0.7%	2.1%	-0.6%	0.3%
	Final Electricity Consumption per Capita (Kwh)												
EU-28	5197	5317	5364	5475	5577	5630	5711	5725	5726	5408	5647	5525	5546
EU-15	5908	6032	6075	6181	6278	6327	6384	6376	6346	5990	6247	6074	6104
NMS-13	2738	2822	2850	2956	3054	3103	3250	3327	3419	3230	3387	3447	3433
% EU 28		2.3%	0.9%	2.1%	1.9%	1.0%	1.4%	0.2%	0.0%	-5.6%	4.4%	-2.2%	0.4%
% EU 15		2.1%	0.7%	1.8%	1.6%	0.8%	0.9%	-0.1%	-0.5%	-5.6%	4.3%	-2.8%	0.5%
% NMS 13*		3.1%	1.0%	3.7%	3.3%	1.6%	4.7%	2.4%	2.7%	-5.5%	4.9%	1.8%	-0.4%
	Residential Electricity Consumption per Capita (Kwh)												
EU-28	1479	1525	1539	1603	1620	1629	1647	1626	1638	1633	1680	1590	1642
EU-15	1690	1745	1757	1823	1841	1845	1856	1827	1832	1824	1876	1763	1827
NMS-13	747	759	772	821	825	845	882	883	913	921	942	935	940
% EU 28		3.1%	0.9%	4.2%	1.1%	0.5%	1.1%	-1.3%	0.8%	-0.3%	2.8%	-5.4%	3.3%
% EU 15		3.2%	0.7%	3.8%	1.0%	0.2%	0.6%	-1.6%	0.3%	-0.5%	2.8%	-6.0%	3.7%
% NMS 13*		1.5%	1.7%	6.4%	0.6%	2.4%	4.4%	0.2%	3.4%	0.8%	2.3%	-0.7%	0.5%
	Electricity prices												
EU-28										0.1636	0.1700	0.1820	0.1917
% EU 28											**3.9%**	**7.1%**	**5.3%**

Residential Electricity - Population

Residential electricity consumption per capita has changed from 1479 Kwh/capita in 2000 to 1642 Kwh/capita in 2012 which is an increase of 11%. In EU-15 the change was 8.1% growth while in NMS-13 growth was 25.8% In NMS-13 per capita residential electricity is 940 kWh which is almost half from 1837kWh in EU-15. In 2009 there is a decline in the per capita residential electricity consumption, while the total residential consumption has increased slightly by 0.1%.

Fig. 74 Residential electricity consumption per capita, 2000-2012 in EU-28, EU-15, NMS-13. Data: Eurostat

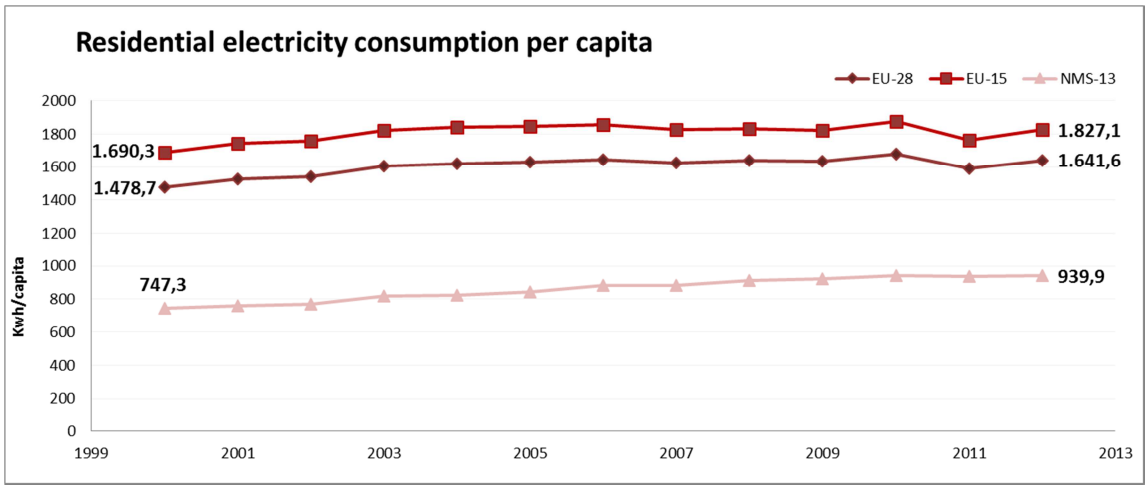


Fig. 75 Comparison of annual changes of residential and final electricity consumption per capita in EU-28. Data: Eurostat.

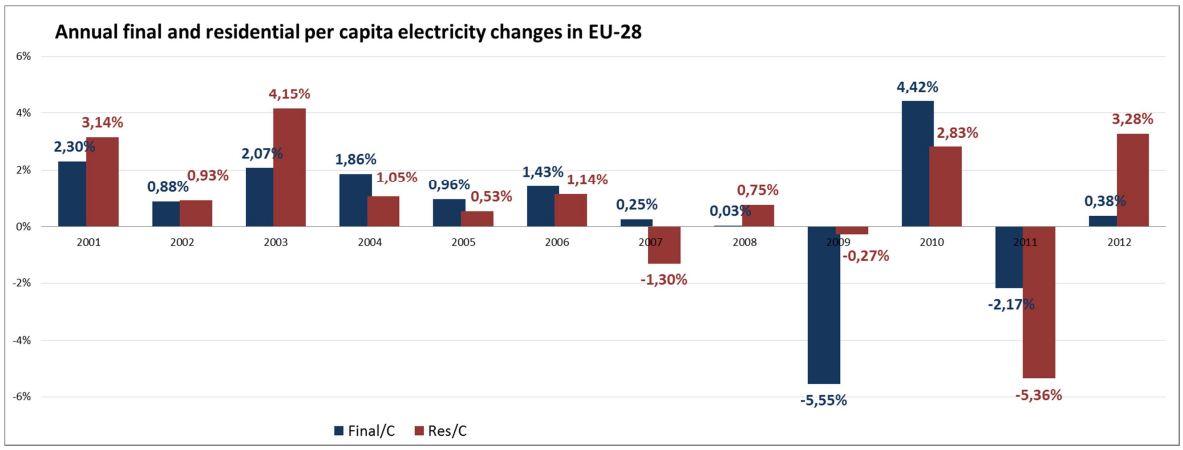
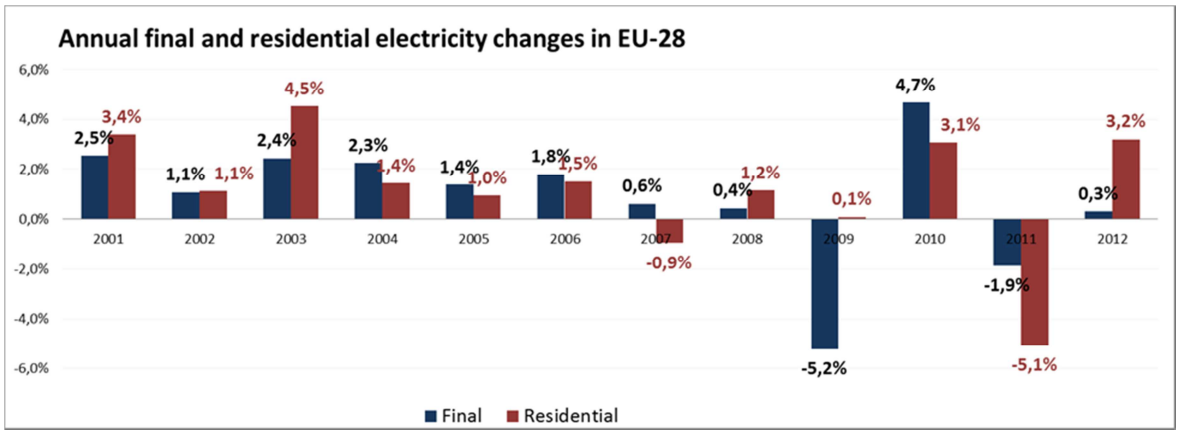


Fig. 76 Annual changes of residential and final electricity consumption in EU-28 Data: Eurostat.



The consumption of residential electricity per capita can change according to different GDP per capita and floor area per capita Fig. 77 Residential electricity per capita for GDP per capita, EU-28. Eurostatshows the residential electricity per capita divided by GDP per capita. In contrast to residential electricity per capita, where there was growth, here there was a decline of -41%. Fig. 78 shows these changes for each member state. In all of the member states there was decline. In Romania the value was very high in 2000, but it declined significantly by 2012.

Fig. 77 Residential electricity per capita for GDP per capita, EU-28. Eurostat

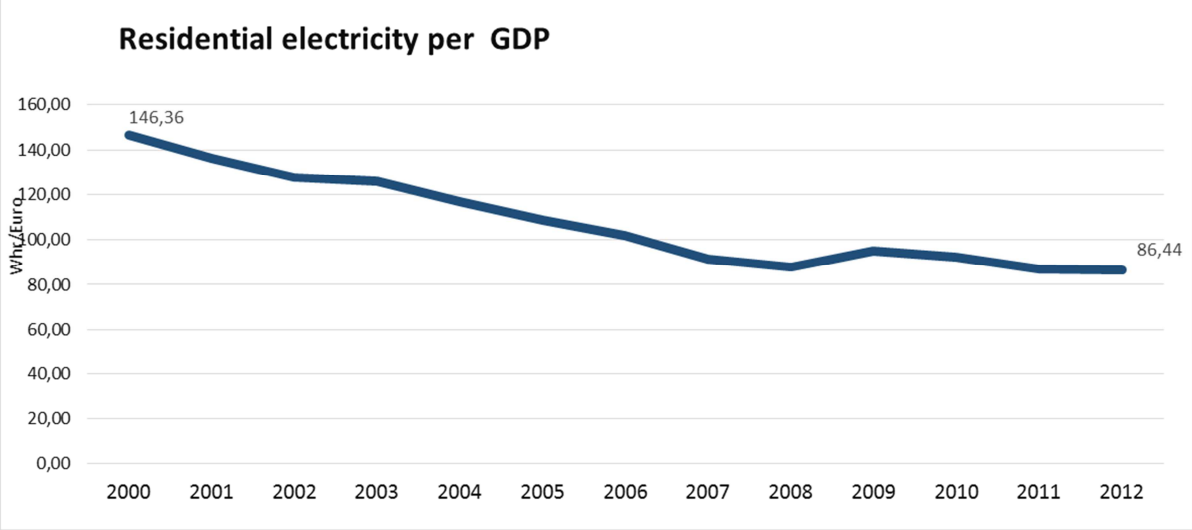
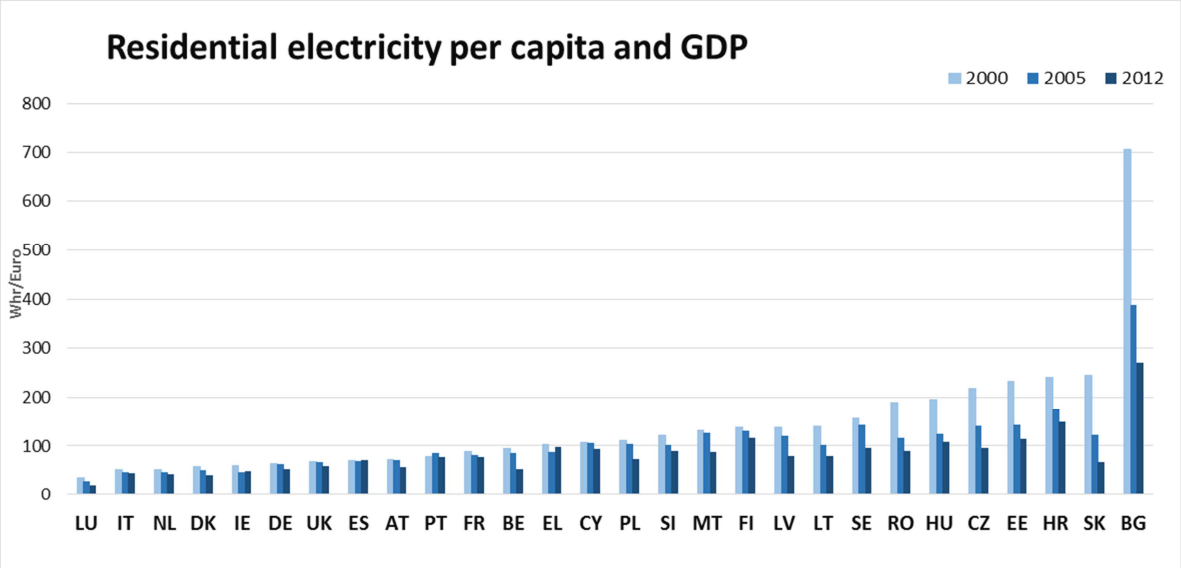


Fig. 78 Residential electricity per capita and GDP per capita in EU-28. Eurostat



Floor area per capita can affect energy consumption as well. Fig. 79 shows the total change of the residential electricity per capita divided by GDP per capita and floor area per capita. As in the previous graph, there is also here large decline of approximately 51%. Fig. 80 shows these changes for different member states. Here Bulgaria and Romania have the highest values in 2000. Despite the large decline, by 2010, they still have some of the highest values. Another relevant aspect in energy consumption is HDD. However HDD is more connected to gas consumption because it is used for heating purposes. By taking all three aspects into account (GDP/c, floor area/c and HDD) in

Fig. 81, there is still decline of 57%. Bulgaria, Romania and Croatia, have also here very high values, but there has been here large decline as in the previous graphs.

Fig. 79 Residential electricity per capita normalized by GDP per capita and floor area per capita in 19[12] member states. Eurostat

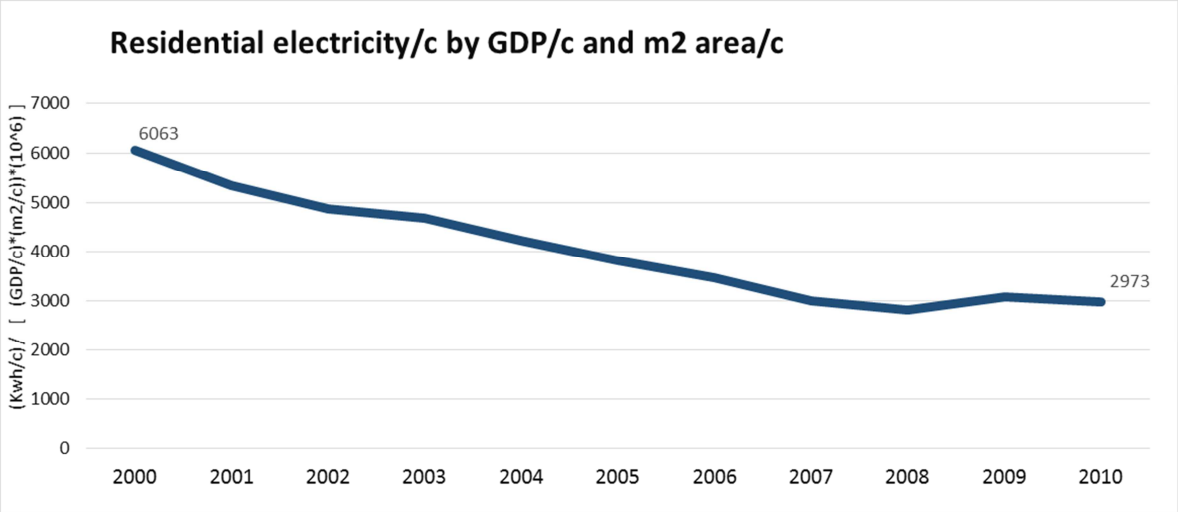
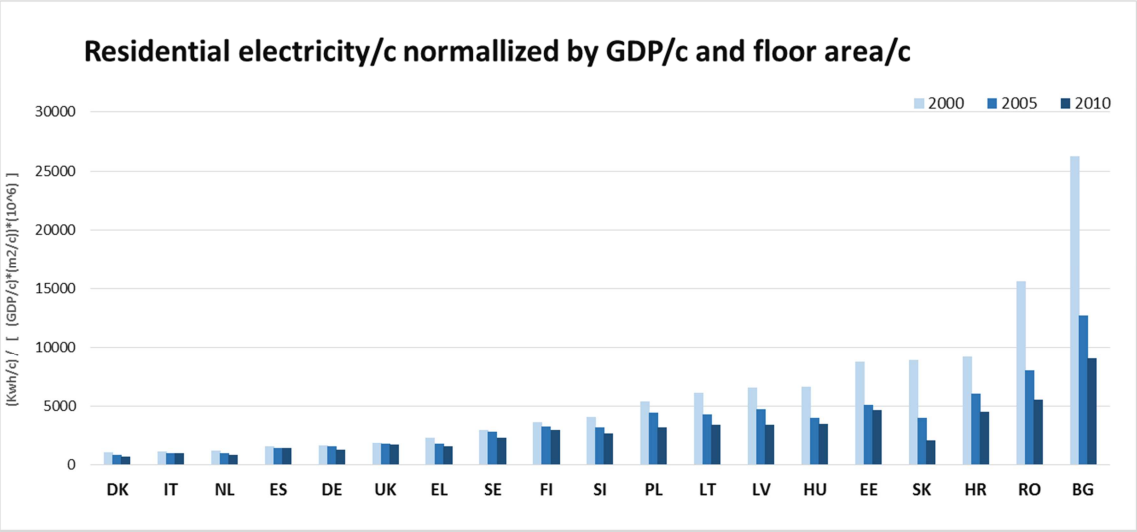


Fig. 80 Residential electricity per capita normalized by GDP per capita and m2 per capita in 19[12] member states. Eurostat, Odyssee



[12] Only for member states with complete floor area data

Fig. 81 Residential electricity per capita normalized by GDP/c, m2/c and HDD in 19[12] member states. Eurostat, Odyssee

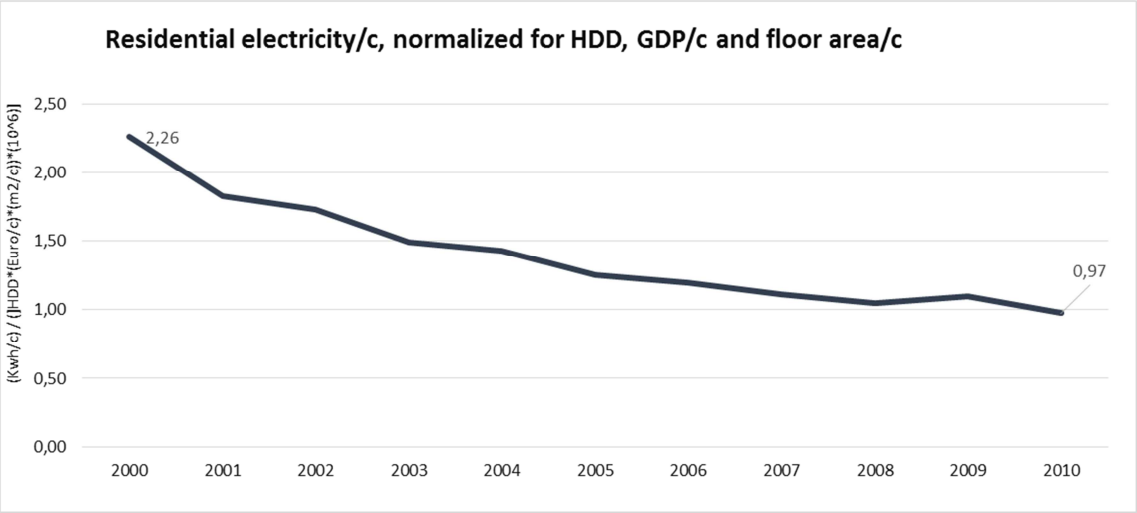
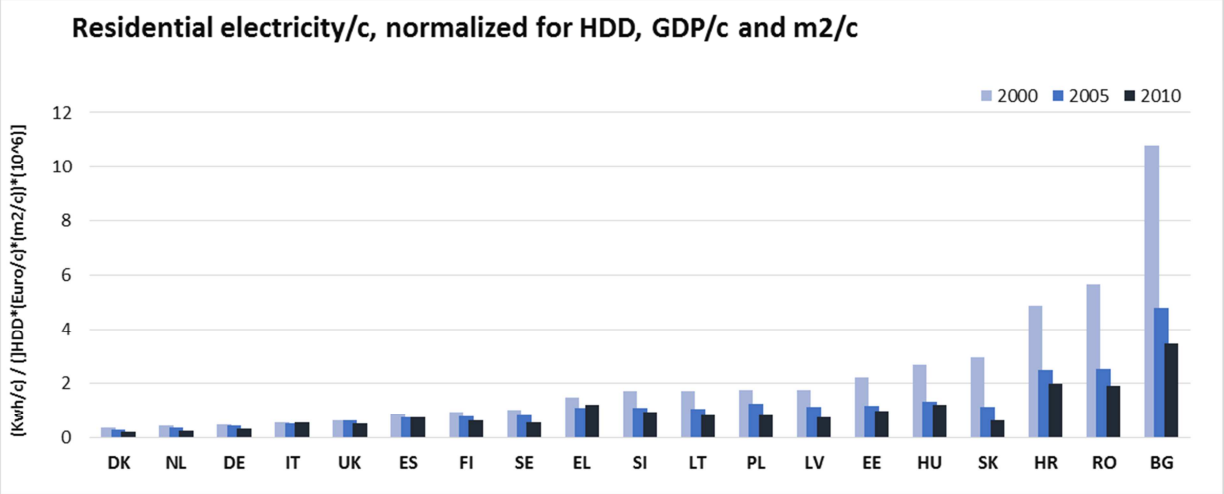


Fig. 82 Residential electricity per capita normalized by GDP/c, m2/c and HDD in 19[12] member states. Eurostat



Another option to measure energy consumption is to calculate the residential electricity per capita, without the effects of GDP. Fig. 83 shows that the average residential electricity per capita, HDD and square meter, which has declined. Cyprus has the largest value. When looking into the other member states, it can be seen that there is very large variation.

Fig. 83 Residential electricity per capita, HDD and m^2 Data: Odyssee, Eurostat.

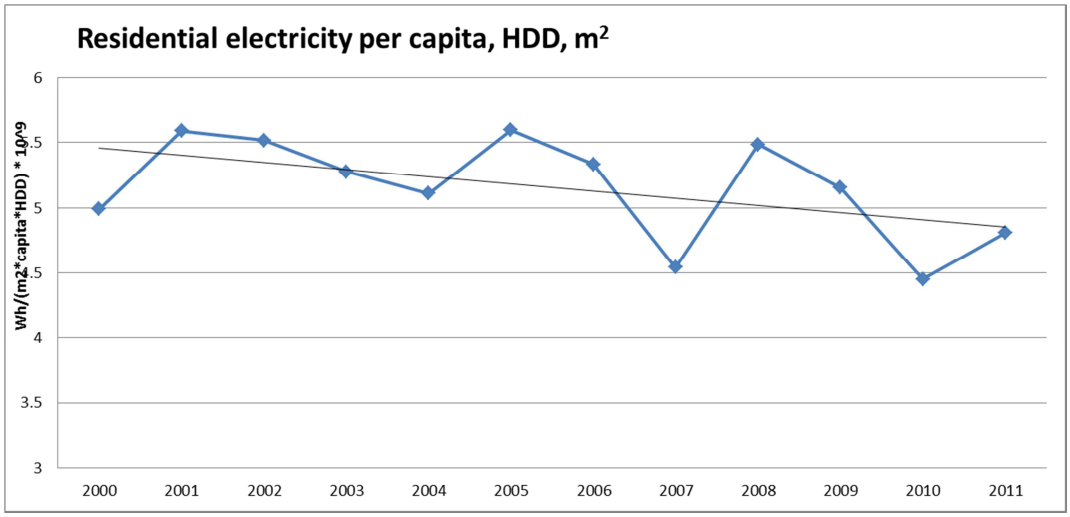


Fig. 84 Residential electricity per capita, HDD and m^2 Data: Odyssee, Eurostat.

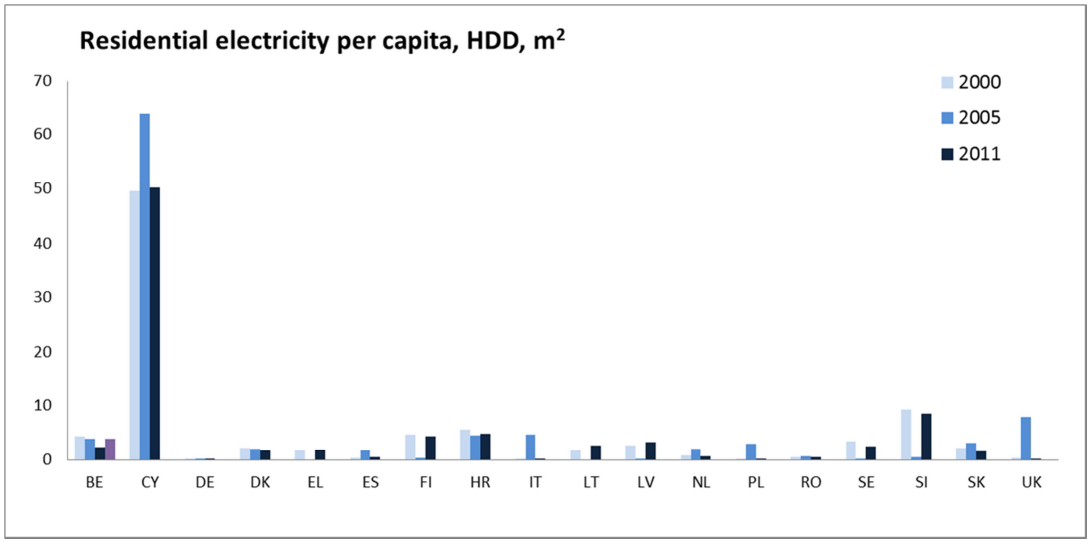
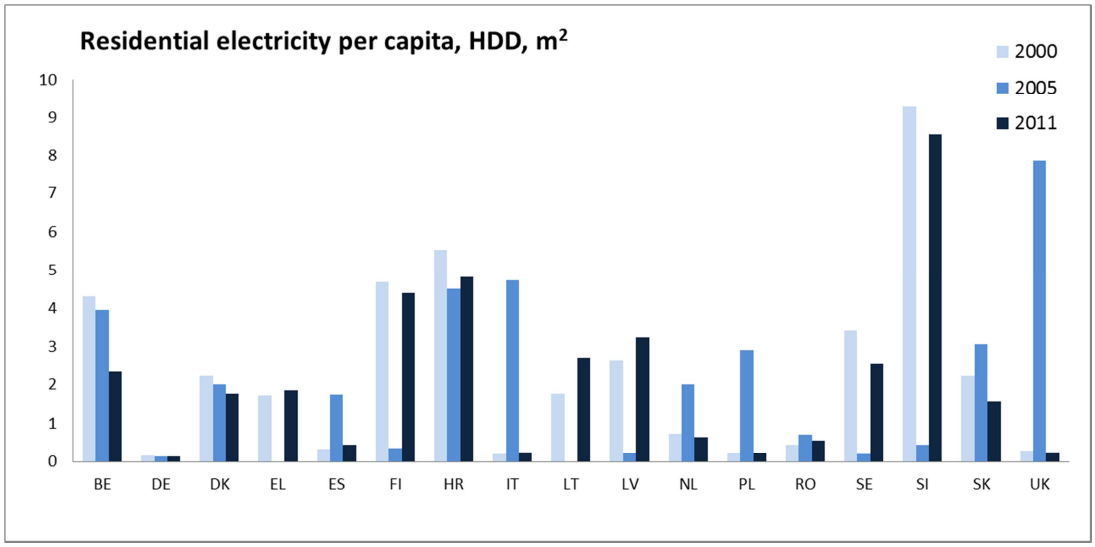


Fig. 85 Residential electricity per capita, HDD and m^2 "Excluding Cyprus" Data: Odyssee, Eurostat.

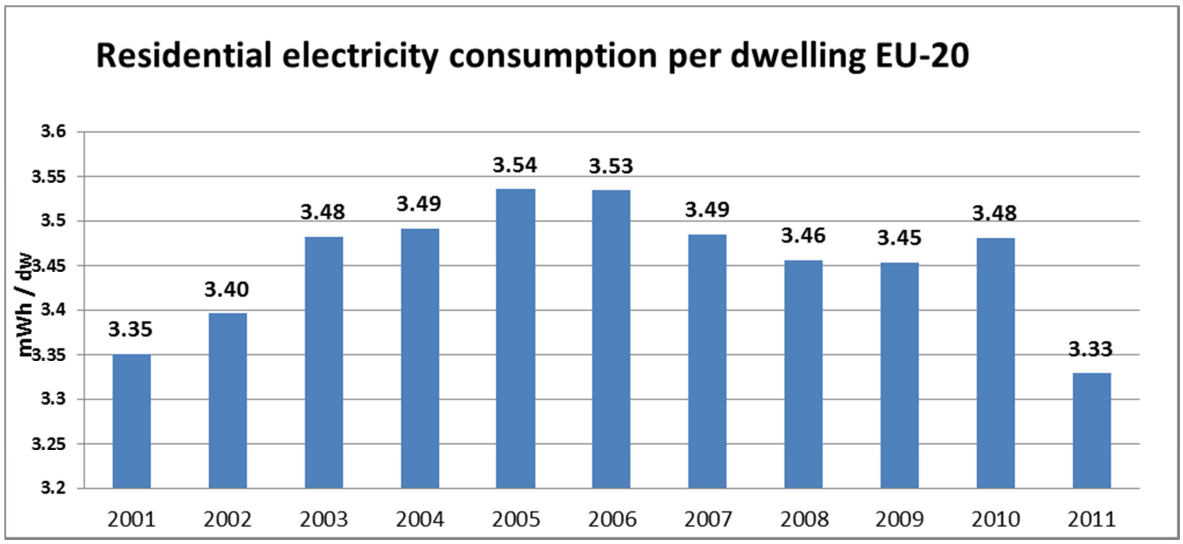


Residential Electricity-Dwelling

Residential electricity consumption per dwelling dropped by 0.6% from 2001-2011 (

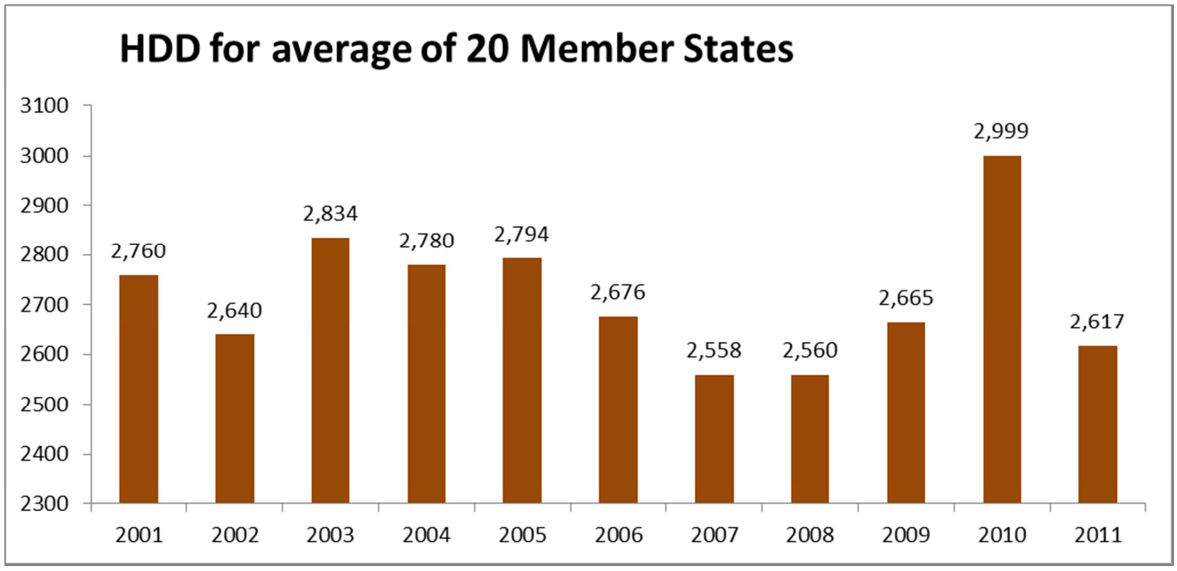
Fig. 86). From 2001 to 2005 it grew by 5.6 % from 3.35 to 3.54 MWh/dw. From 2007 it started to decline. In 2010 there was small growth and the consumption reached again the same value as the one on 2003. The following year, 2011 there was further reduction and the residential electricity consumption reached to the smallest value of the period 2001-2011. The growth in 2010 can be attributed in the high number of degree days of this year. However, it is important to note that the heating degree days in 2010 (2999 HDD) were higher than those of 2003 (2834 HDD) (Fig. 87). In 2011 the HDD were almost the same with those of 2007, however electricity consumption was much lower. In contrast, in 2001 besides the low electricity consumption the HDD were equal to the values of 2005.

Fig. 86 Residential electricity consumption per dwelling in EU[13]. Data: Eurostat, Odyssee



[13] Excludes AT, CZ, FR, IE, LU, MT, HU, EE due to incomplete data for 2011.

Fig. 87 Average HDD for the 20 Member states with dwelling data [13] Data: Odyssee



Looking at electricity consumption per dwelling across EU Member States a large dispersion of consumption levels is registered. Finland and Sweden have the highest residential electricity consumption per dwelling (Fig. 88). In Finland besides a high HDD value, there is widespread use of saunas which can be found in many households. In Sweden, there is also very high residential consumption per dwelling, but heating degree days are lower than those of Poland, Germany, Latvia and Lithuania. In these member states however residential electricity consumption is much lower. This could be explained by the use of different heating methods such as heat pumps in Sweden. In member states with high electricity consumption levels such as, Finland, Sweden, UK, there seems to be a reduction of consumption in time, while in member states with the lowest levels (Latvia, Lithuania, Poland Romania) consumption has increased. However it is important to note that the HDD are different as well for each member state. For the above mentioned member states with the highest and lowest residential electricity consumption, HDD have declined (

Fig. 89). However for some member states like Cyprus, Bulgaria and Italy, HDD did not decline or even slightly increased from 2001-2011 and residential electricity has increased as well. It is important to note that consumption per dwelling does not show the consumption pattern of a typical dwelling but it includes a wide variety of very different dwellings and household characteristics. The average includes very small or large dwellings, households as well as low income and high income households etc.

Fig. 88 Residential electricity per dwelling for different member states[13], Data: Eurostat, Odyssee

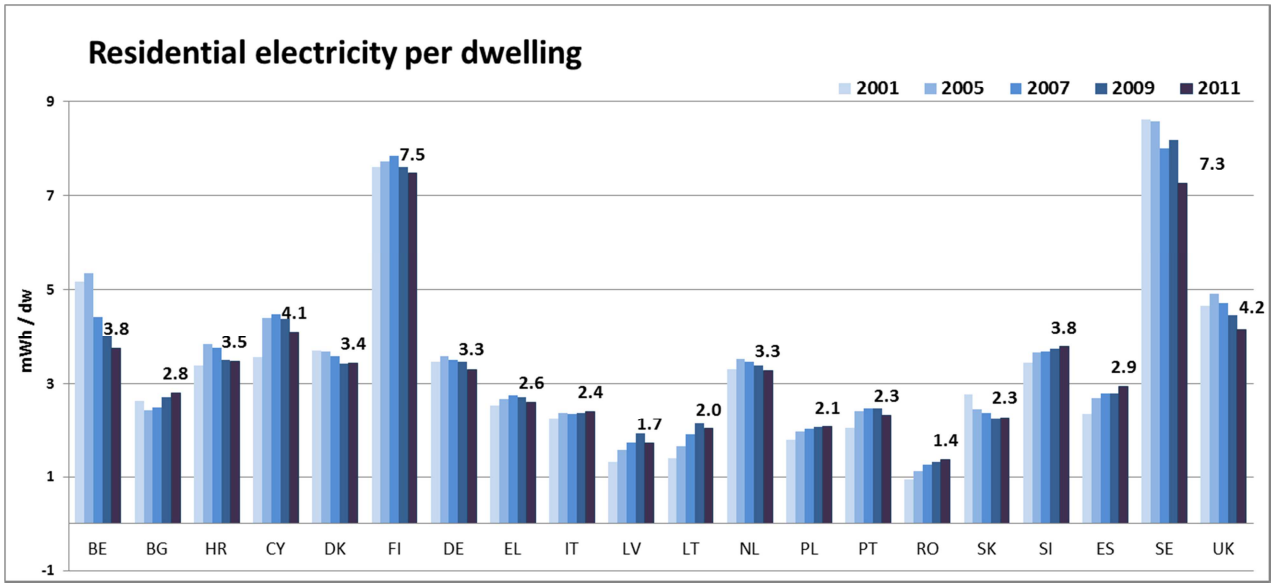


Fig. 89 shows the heating degree days per member state for the same years that were used for Fig. 88. For Finland the highest consumption was in 2007 while the higher HDD were in 2009.For Sweden however the changes in the residential electricity per dwelling seem to follow better the changes in HDD.

Fig. 89 Heating Degree Days in member states for 200012005,2007,2009,2011. Data: Odyssee

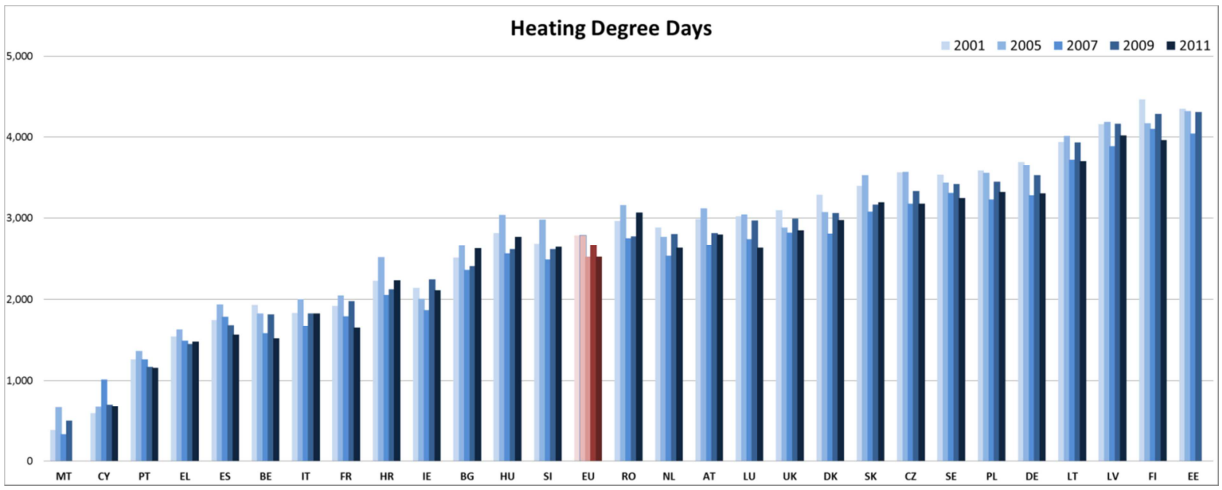


Fig. 90 Residential electricity per dwelling and HDD for average of 19 Member States, Data: Odyssee, Eurostat.

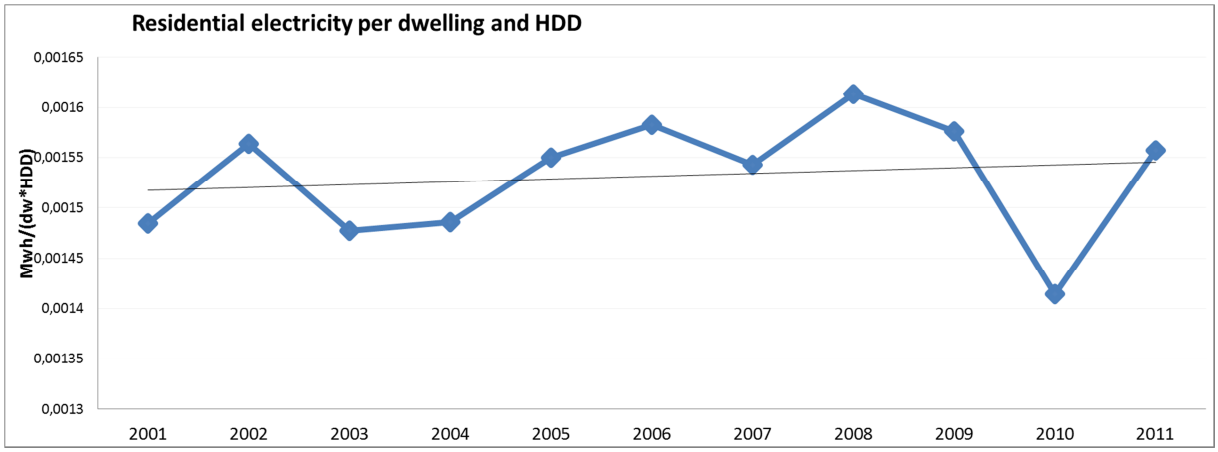
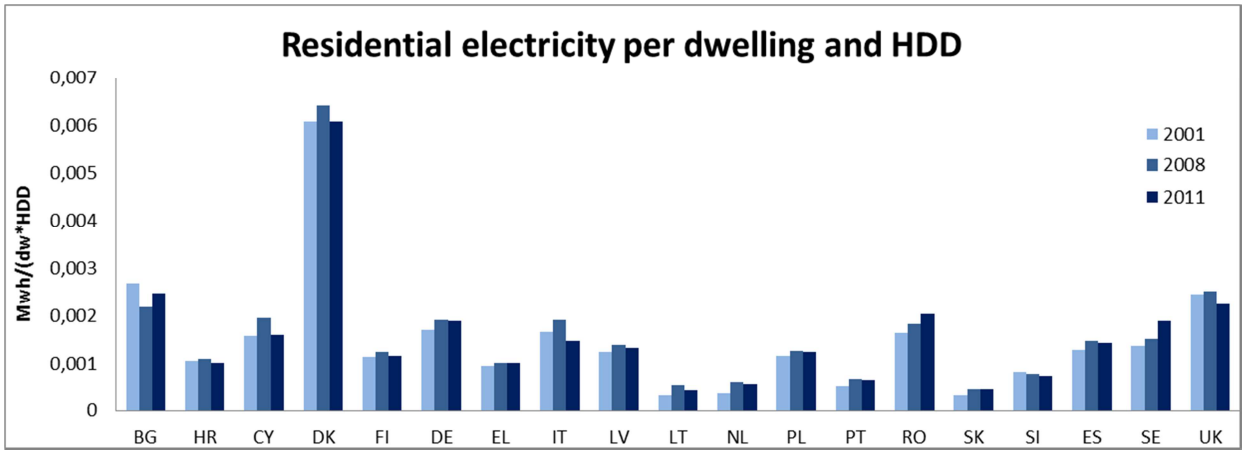


Fig. 90 shows the average residential electricity per dwelling and per HDD for 19 member states. On average there seems to be a growth from 2001-2011.

Fig. 91 shows the same information per member state for 2001, 2008 and 2011. In eleven member states there has been growth. Decline can be seen for Bulgaria, Italy, Slovenia and UK. For Finland, Denmark, Cyprus and Hungary the value for 2001 is almost similar to the one for 2011.

Fig. 91 Residential electricity per dwelling and HDD for 19 Member States, Data: Odyssee, Eurostat.



Residential Electricity –price trends

Electricity prices differ to a large extent across the European Union. Denmark, Cyprus and Germany have relatively high electricity prices, e.g. 0.29845 € per kWh electricity in Denmark for 2012. Bulgaria and Romania and Estonia have comparatively low electricity prices with the lowest 0.09005 € per kWh in Bulgaria. During the last years, electricity prices have increased in the EU-28. From an average price of 0.1562 € per kWh electricity in 2007 the price increased to 0.1917 € per kWh electricity in 2012 (

Fig. 93). This means an increase of 22.7% during this period. The influence of the price of electricity consumption is, however, not that large since electricity demand is generally quite inelastic.

Fig. 92 Electricity prices with taxes and levies in EU-28: Band DC : 2500 kWh < Consumption < 5000 kWh. Data:Eurostat

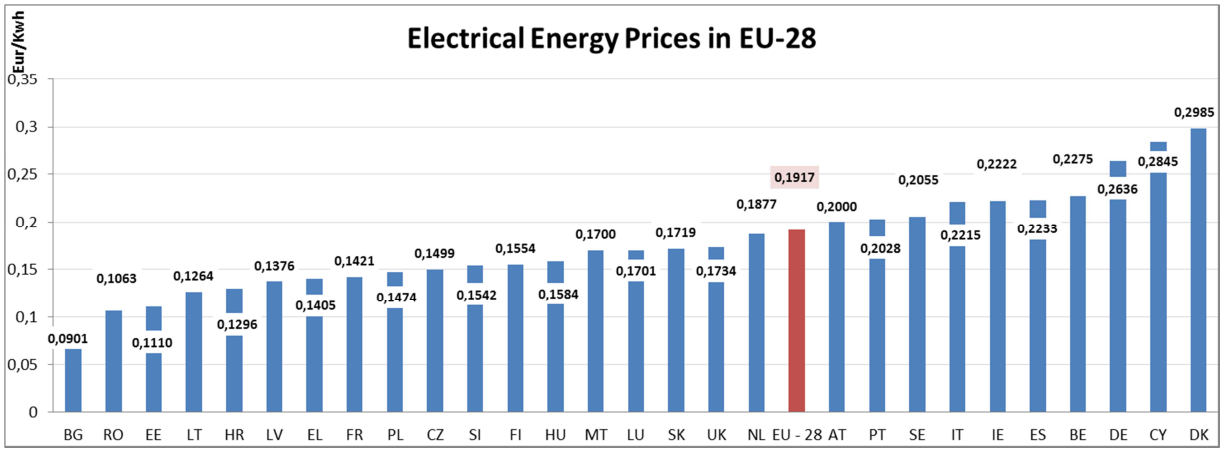
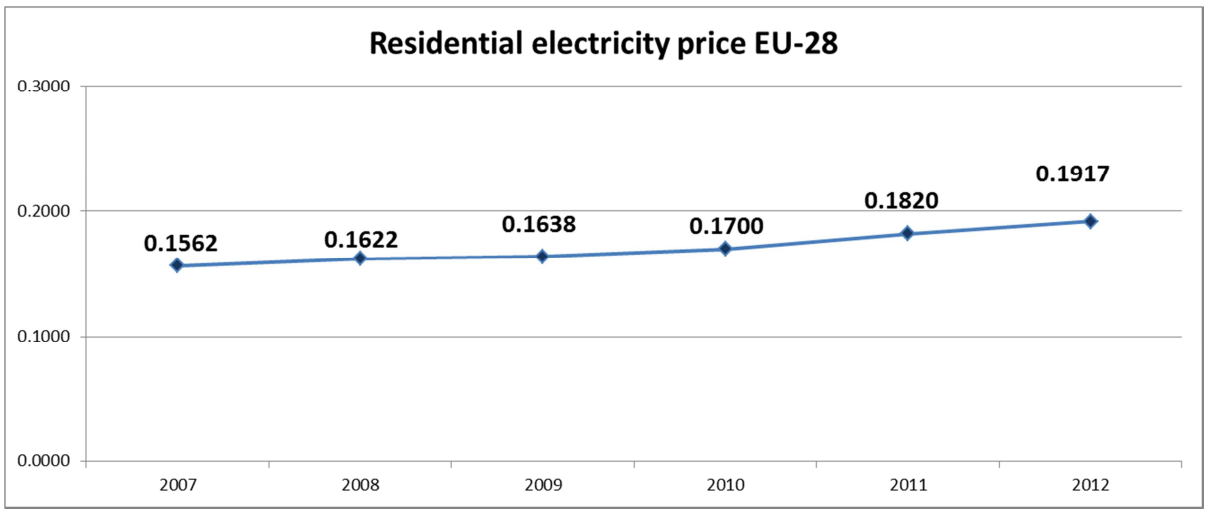


Fig. 93 Residential electricity price trends 2500kWh < Consumption < 5000 kWh. All taxies and levies included. Data: Eurostat.



Overview – Residential Sector

Residential energy consumption has slightly declined in 2012 compared to 2000, by 2%. The changes in the consumption can be described by two main periods. First from 2001 -2006 residential energy is constantly higher compared to 2000, while after 2007 the residential energy consumption was lower than that of 2000. The only exception is 2010 when residential energy consumption grew significantly but that was also the year when heating degree days hit the highest point for 2000-2012.

Residential energy consumption is related to heating degree days, because heating demand is the main energy driver of the residential sector. Therefore the annual changes follow a similar pattern both in residential energy consumption and in HDD, which have been also lower after 2007. However on years 2008, 2009 and 2012, the heating degree days were high enough and could have led to more residential energy consumption than the one observed. Energy efficiency improvements or the effects of economic crisis could explain these lower levels of final residential energy consumption.

Other changes that could affect residential energy consumption are population, GDP, number of people per household and dwelling size. Population has increased [14] (+4%) while the average

[14] Unless stated, changes refer to 2000-2012

number of people per household has declined (-8% for 2005-2012). Both of these changes would lead to additional residential energy consumption. Average dwelling size has increased (+3.9%) and larger dwellings are more difficult to heat. Last, GDP per capita has increased significantly in all of the member states. Although the interaction of GDP with the energy consumption is not always straightforward, there are indications that in member states with low GDP, GDP growth often leads to increase of residential energy consumption. In contrast in member states with high GDP, further growth is not always accompanied with additional consumption growth.

More than half of the energy requirements for residential energy consumption come from electricity and gas, with gas being the largest energy source for the residential sector. Compared to 2000, the role of gas has declined at the expense of electricity growth. Residential gas consumption dropped by -4% while residential electricity consumption grew by +15%. The decline is residential gas consumption is translated also as a decline in the residential gas consumption per capita (-7.4%) and residential gas per dwelling[15] (-15.6% for 2001-2011). Gas consumption per capita divided by the average heating degree days, shows that after 2006 there is a very constant decline.

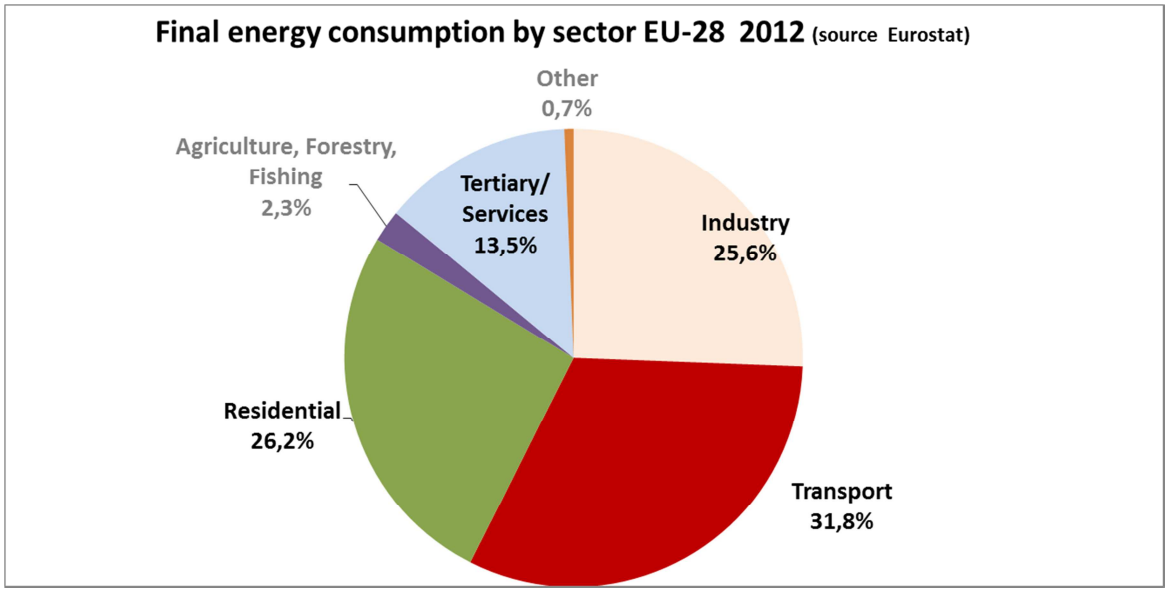
In contrast to gas consumption, the residential electricity per capita grew by +11%. Residential electricity per dwelling[15] dropped by 0.6% for 2001-2011, but this is probably related to very low heating degree days on 2011. For the period 2000-2012, final and residential electricity consumption (but also final and residential electricity consumption per capita), have been every year higher than the consumption of 2000. However, when looking into the annual changes, there have been some years (2007, 2011) when there was decline of the residential electricity consumption.

It is important to add that there are very large member state variations. When separating the results into NMS-13 and EU-15, it becomes obvious that in NMS-13 total residential energy consumption has not declined at all from 2000, residential gas consumption dropped only in 2007 below the levels of 2000 while electricity consumption has been always higher than that of 2000. However it is important to note that only a 17% of the final residential consumption in EU-28 is consumed in NMS-13 which includes the 20% of the EU-28 population. Also there has been very large GDP/capita growth in NMS-13 which can be connected to the increase of energy consumption. Last it is important to note that HDD are higher in NMS-13 compared to EU-15, which could suggest that residential energy consumption will increase further in the future until the same levels of comfort will be achieved.

[15] Dwelling data refer to 2001-2011

3. Tertiary Sector

Fig. 94 Breakdown of energy consumption-Services Data: Eurostat



The Tertiary Sector refers to public sector and the commercial services which include: wholesale and retail trade, transport, information and communication, financial activities, real estate, professional activities and arts. The tertiary sector accounts for 13.5% of the final energy consumption in EU-28 (Fig. 94, Public sector and Services). Besides this small share of final energy consumption, the gross value added (GVA) by the tertiary sector is 73.4%, an increase of 3.5% in the share of GVA compared to 2000 (Fig. 95). Compared to 2000, GVA went up by 47% (

Fig. 96). It is expected that the tertiary sector will grow further in importance in the future.

Fig. 95 Gross Value added by sectors in %. Data: Eurostat

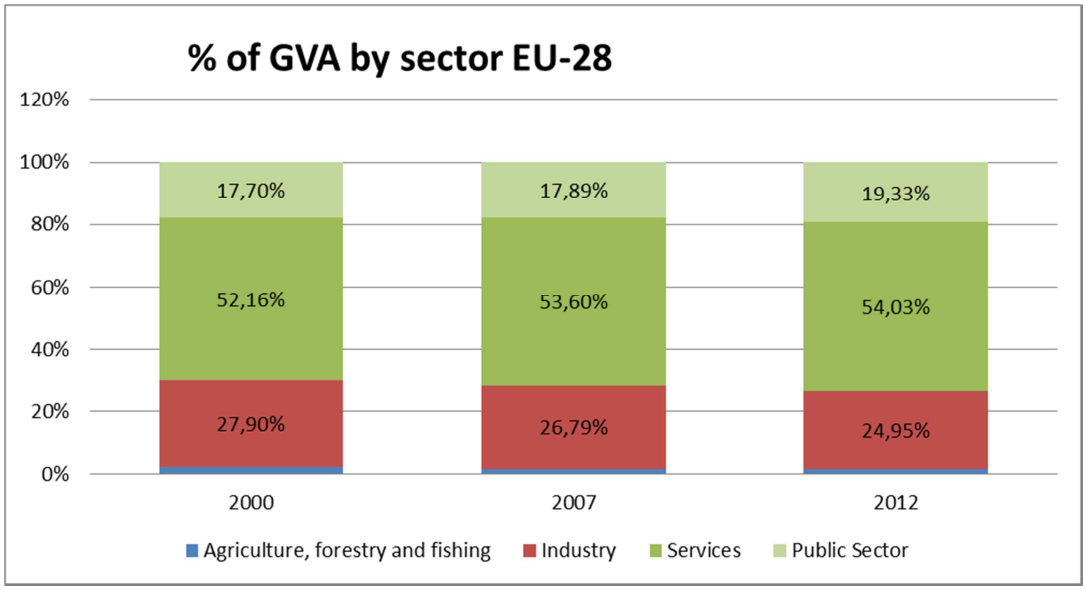
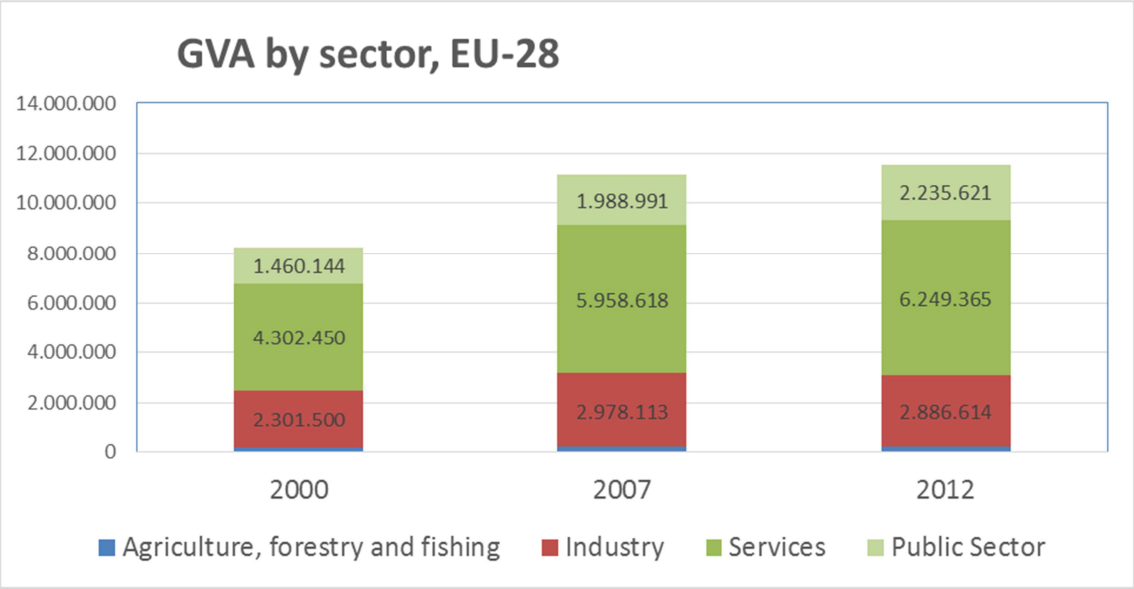


Fig. 96 Gross Value added by sectors. Data:Eurostat



Final energy consumption

From 2000-2012, tertiary final energy consumption has increased considerably. In 2000 it was 117 Mtoe (EU-28) and the figure grew to 149 Mtoe in 2012, an increase of 27.2% (Table 8). Although the growth pattern was similar in EU-15 and NMS-13, consumption grew slightly more in EU-15, by a rate of 27.4%, while the growth for NMS-13 was 25.7%. In 2007 there was a drop compared to the average trend the years before (Fig. 97). In 2010, in EU-28, there was a peak of energy consumption, while the following year consumption dropped by 6.8%.

Fig. 97 Tertiary final energy consumption EU-28, EU-15, NMS-13, Data: Eurostat

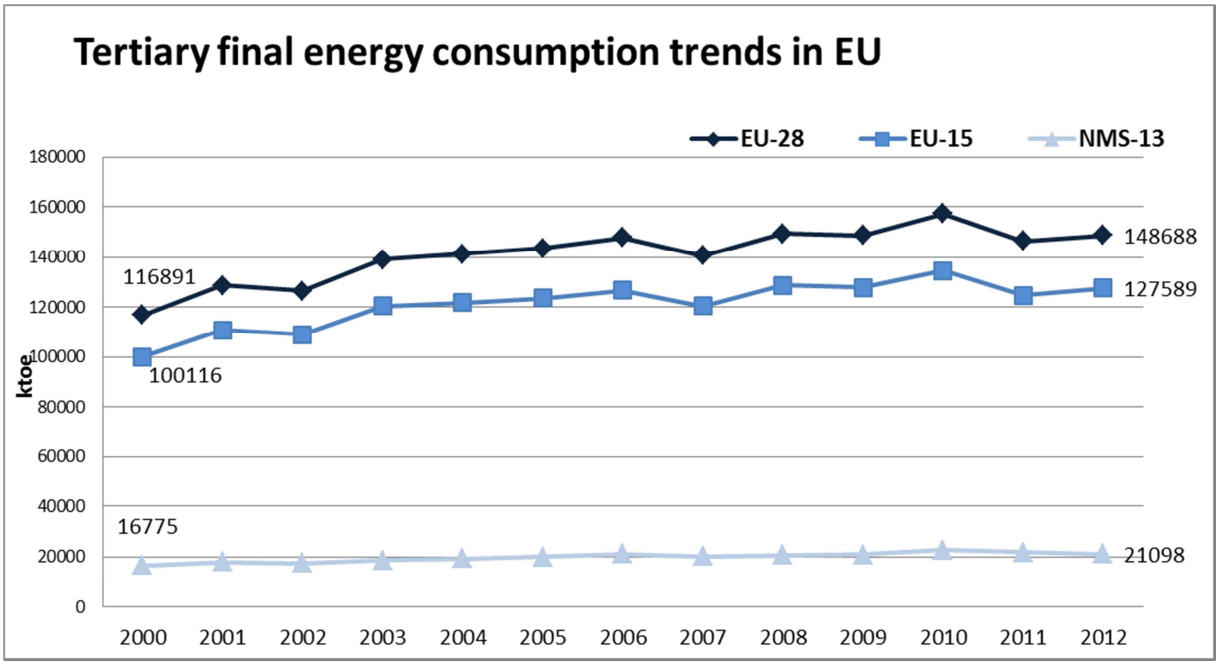


Fig. 98 Tertiary final energy consumption EU-28, Data: Eurostat

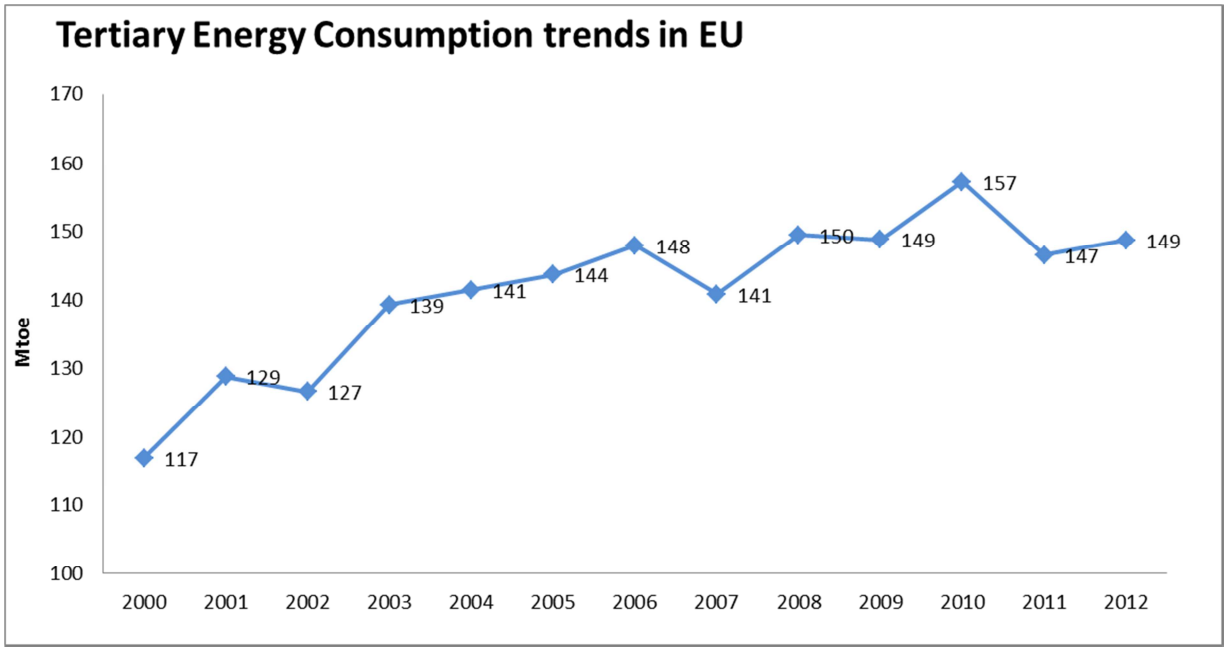


Table 8 Tertiary final energy consumption-growth rates. , Data: Eurostat

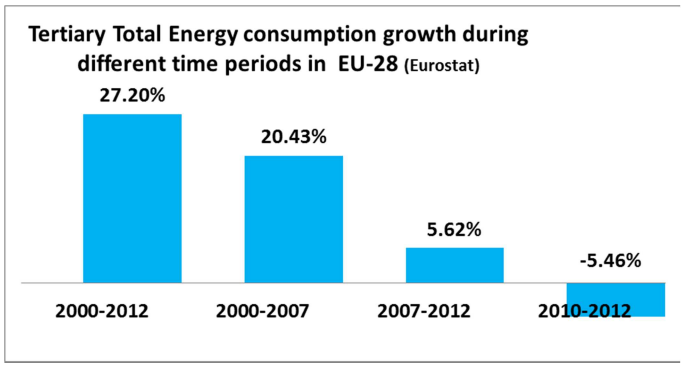
Tertiary energy consumption													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	116891.2	128815.4	126617.6	139230	141427.8	143695.1	147953.7	140776.5	149506.9	148823.5	157281.2	146531	148687.7
EU-15	100116.2	110817.7	108987.7	120584.4	121929.2	123673.3	126767.4	120546.4	128715.1	127800.6	134560.7	124688.9	127589.3
NMS-13	16774.9	17997.7	17630	18645.7	19498.7	20021.7	21186.4	20230.2	20791.9	21022.9	22720.4	21842.2	21098.4
% compared to 2000													
% EU 28		10.2%	8.3%	19.1%	21.0%	22.9%	26.6%	20.4%	27.9%	27.3%	34.6%	25.4%	27.2%
% EU 15		10.7%	8.9%	20.4%	21.8%	23.5%	26.6%	20.4%	28.6%	27.7%	34.4%	24.5%	27.4%
% NMS 13*		7.3%	5.1%	11.2%	16.2%	19.4%	26.3%	20.6%	23.9%	25.3%	35.4%	30.2%	25.8%
annual change													
% EU 28		10.2%	-1.7%	10.0%	1.6%	1.6%	3.0%	-4.9%	6.2%	-0.5%	5.7%	-6.8%	1.5%
% EU 15		10.7%	-1.7%	10.6%	1.1%	1.4%	2.5%	-4.9%	6.8%	-0.7%	5.3%	-7.3%	2.3%
% NMS 13*		7.3%	-2.0%	5.8%	4.6%	2.7%	5.8%	-4.5%	2.8%	1.1%	8.1%	-3.9%	-3.4%

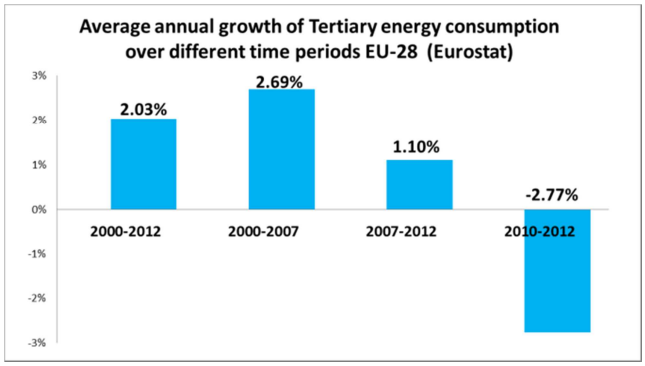
Although there was significant growth of tertiary final energy consumption of 27.20% in EU-28 from 2000 onwards, the largest part (26,6%) of this growth took place between 2000-2006 (Table 8). In 2003 tertiary consumption grew by 11% in just one year. From 2007-2010 there was 14.2% growth while in the period 2010-2012 there was a decline of 7.4%[16] (

Fig. 99). For NMS-13 the growth has been less than that of EU-15, while the decline between 2010, 2012 has been larger.

[16] Growth rates here are calculated with base year 2000.

Fig. 99 Total and annual growth rates of tertiary energy consumption over different time periods Data: Eurostat



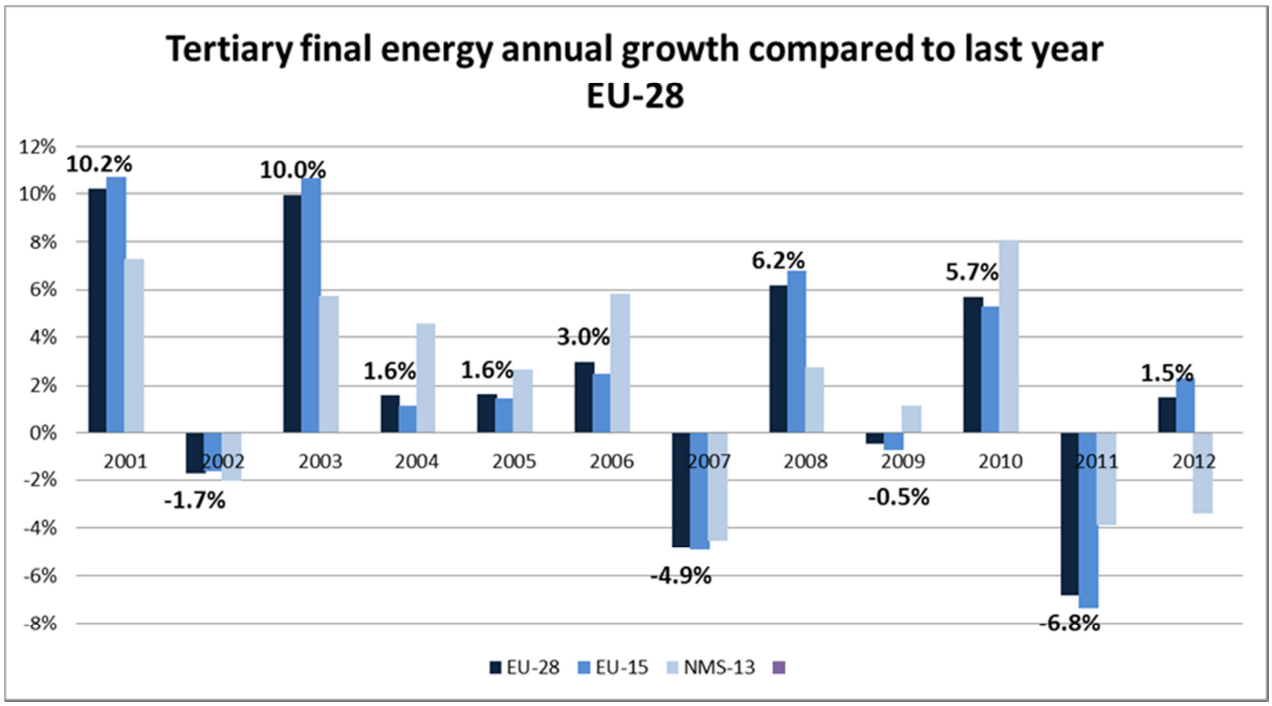


Tertiary Final Energy consumption % Growth during time period				
	2000-2012	2000-2007	2007-2012	2010-2012
EU-28	27.20%	20.43%	5.62%	-5.46%
EU-15	27.44%	20.41%	5.84%	-5.18%
NMS-13	25.77%	20.60%	4.29%	-7.14%

Tertiary Final Energy consumption % Annual Growth per year				
	2000-2012	2000-2007	2007-2012	2010-2012
EU-28	2.03%	2.69%	1.10%	-2.77%
EU-15	2.04%	2.69%	1.14%	-2.62%
NMS-13	1.93%	2.71%	0.84%	-3.64%

When looking at the annual growth rates, it is seen that there is significant annual variation (Fig. 100). For EU-15, in 2002, 2007, 2009 and 2011 there was decline of the final tertiary energy consumption, compared to previous years. In contrast to EU-15, for NMS-13 there was growth in 2009 and decline in 2012.

Fig. 100 Tertiary final energy consumption – Annual growth Data: Eurostat



Compared to 2000, there has been considerable growth in both GVA (+47%) and final energy consumption of the tertiary sector (+27%). Therefore, a way to assess the growth in terms of energy efficiency is to compare the final energy consumption per GVA. Besides some variations there is a downward movement which indicates improvement in energy efficiency. In total tertiary energy consumption per GVA has declined by 13.6% for the period 2000-2012.

Fig. 101 Final energy consumption per GVA, EU- 28 Data: Eurostat

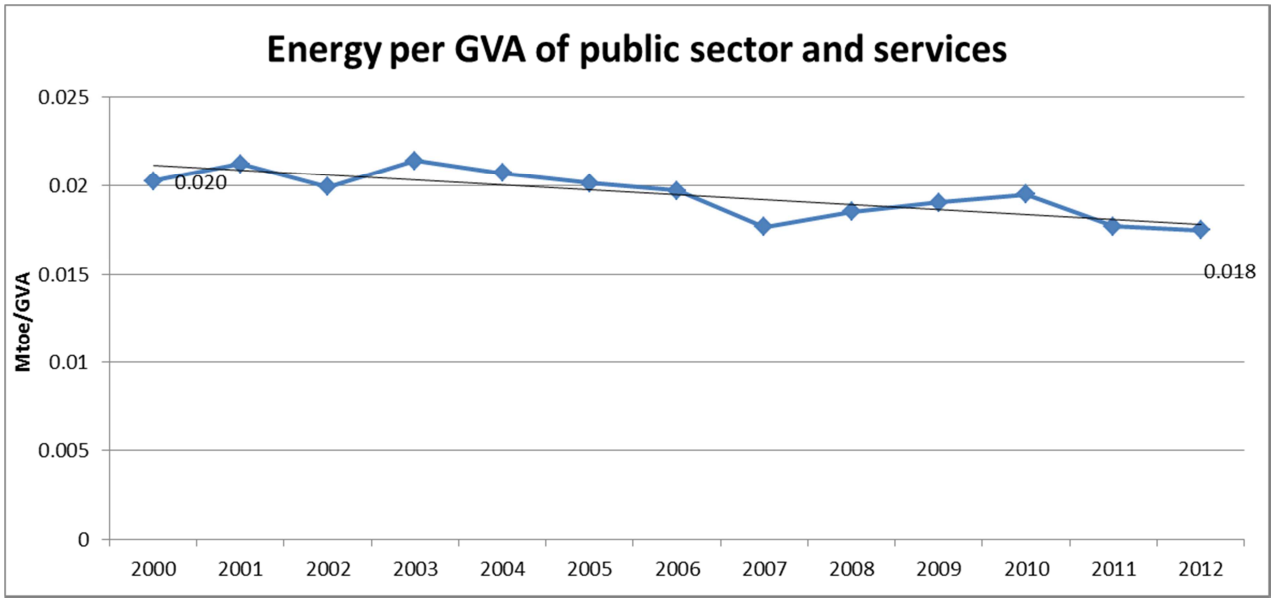
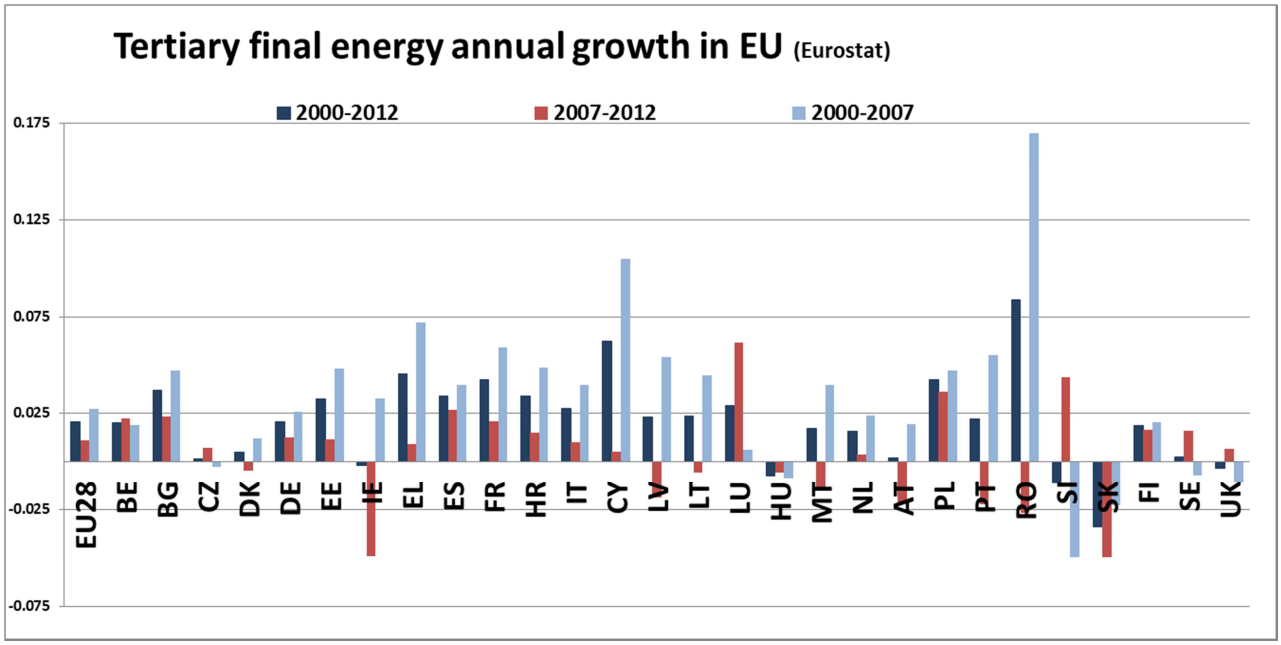


Fig. 102 shows the average annual growth of different member states over different time periods. There is no similar pattern for all the member states. Especially for the period 2007-2012, some member states have reduced their tertiary consumption while in others there was still growth. Many member states (Ireland, Latvia, Lithuania, Malta and Austria) experienced a decline in the energy consumption the period 2007-2012, but there was growth from 2000-2007.

Fig. 102 Average annual growth for member states. Data: Eurostat



Energy consumption per fuel type

The main energy sources of the sector are electricity and gas which account for 48.9% and 30.7% respectively, of the total energy supply (Fig. 103). The total share of both electricity and gas over the other energy types has increased by 7% since 2000 (Table 9). This growth has happened at the expense of oil, which has declined by 8.3% since 2000 (Table 9). It is expected that oil consumption will decrease further in the future, therefore electricity and gas consumption will become even more important. It is important to note that a small part of the increase in gas and electricity consumption is due to the substitution of oil consumption. From 2000-2012 the total change in energy consumption was 32 Mtoe. The breakdown of this number shows that this includes a decline of around 6 Mtoe in energy mainly from petroleum products, and a growth of 39 Mtoe in energy from electricity, gas, heat and renewable energies. If we were to assume that gas and electricity equally absorbed the reduction in the other energy sources then 21% of the gas growth and 18% of the electricity growth, from 2000-2012, can be attributed to substituting the oil consumption decline. This should be taken into account when analysing the energy consumption changes.

Fig. 103 Energy types in tertiary sector. Data: Eurostat

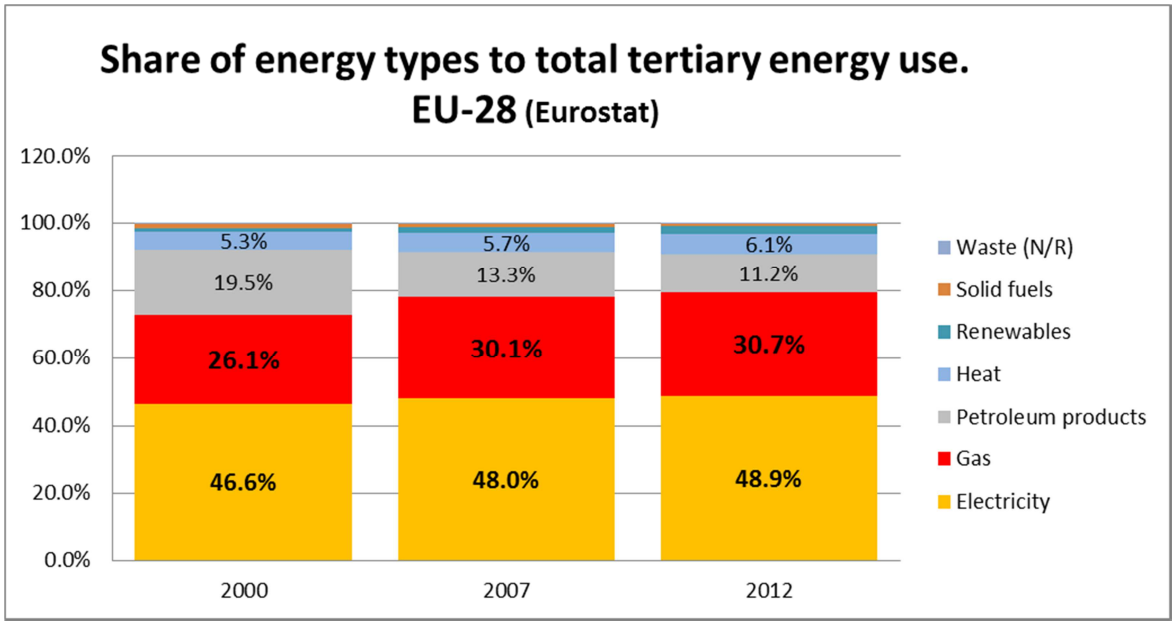


Table 9 Tertiary energy consumption by fuel type-growth rates, Data: Eurostat.

Tertiary energy Consumption	2000	2012	Change in ktoe consumption	Growth	Share of total fuels in 2000	Share of total fuels in 2012	Change of shares
All	116891	148688	31797	27.20%			
Solid fuels	1499	1125	-374	-25.00%	1.30%	0.80%	-0.50%
Total petroleum pr.	22764	16641	-6123	-26.90%	19.50%	11.20%	-8.30%
Gas	30474	45678	15204	49.90%	26.10%	30.70%	4.70%
Derived heat	6243	9095	2853	45.70%	5.30%	6.10%	0.80%
Renewable energies	1252	3311	2058	164.30%	1.10%	2.20%	1.20%
Electrical energy	54431	72647	18216	33.50%	46.60%	48.90%	2.30%
Waste (non-renewable)	229	192	-37	-16.30%	0.20%	0.10%	-0.10%

Energy consumption per employee

There is much diversity in the energy consumption per employee. In 2012 the consumption for EU-28 is 0.986 toe/employee while in 2000 it was 0,961 toe/employee. This is a growth of 26%. Around half of the member states with above average per employee energy consumption (Luxembourg, Slovakia, Sweden, Hungary and Austria) experienced decline from 2000-2010, while in the other half there has been growth. The situation looks the same also for the member states with below EU-28 average energy consumption. In half of them, there has been growth while in the other half decline (Fig. 104). Tertiary energy consumption per employee and floor area, for a small sample of member states (Fig. 105) shows that there has been no growth in the last years. In Finland, Denmark and Sweden there has been decline, while in Germany, France, Spain and Greece, the energy consumption per employee, and floor area is almost the same in 2012 as in 2000. In Finland and Spain there is decline of the energy consumption per employee and floor area, while without taking the floor area into account, there was growth (Fig. 104).

Fig. 104 Tertiary energy consumption per employee for each member state. Data: Odyssee

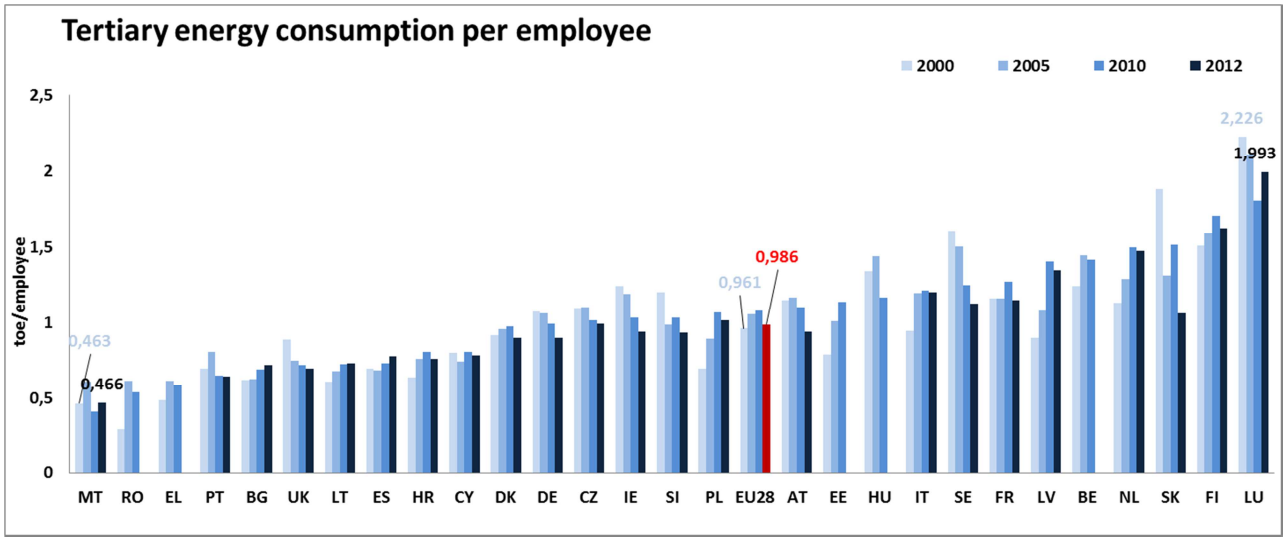


Fig. 105 Final tertiary energy consumption per employee and floor area, Data:Odyssee

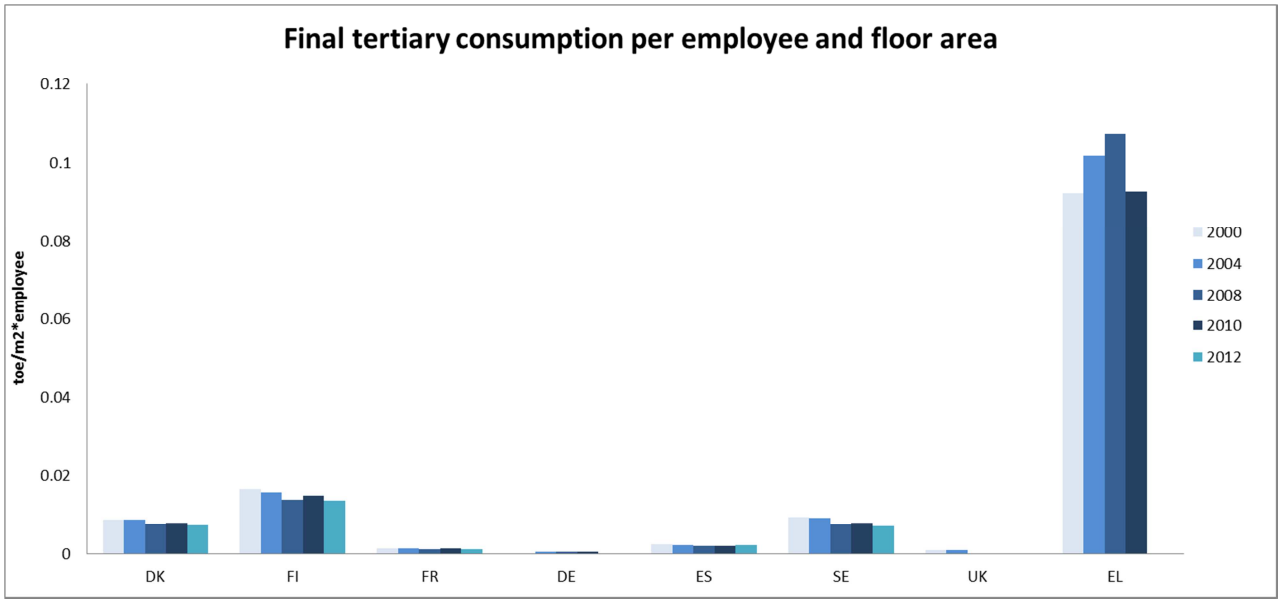
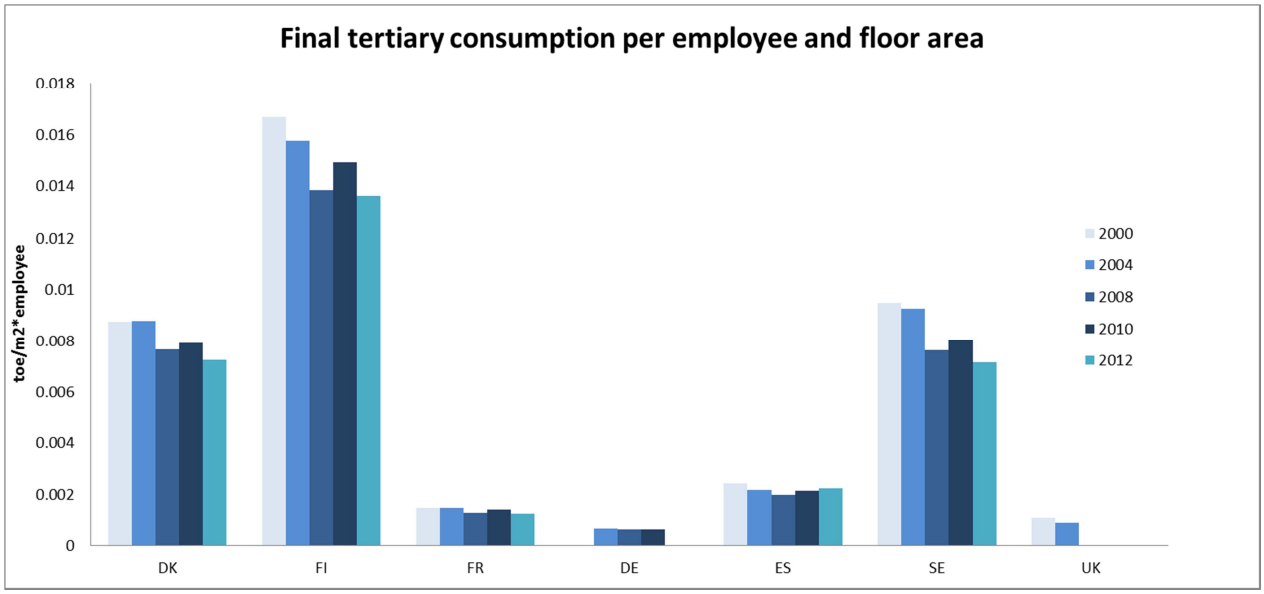
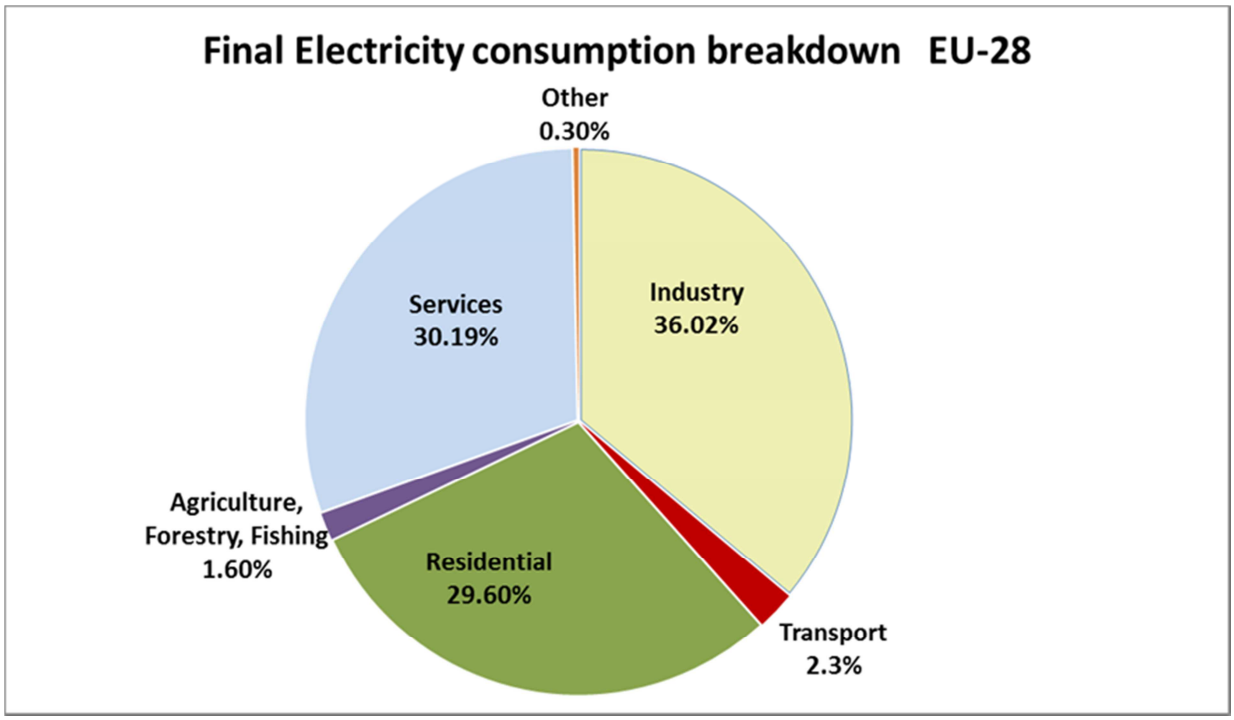


Fig. 106 Final tertiary consumption per employee and floor area (excluding Greece) Data, Odyssee



Electricity Consumption

Fig. 107 Electricity consumption breakdown into sectors Data: Eurostat.



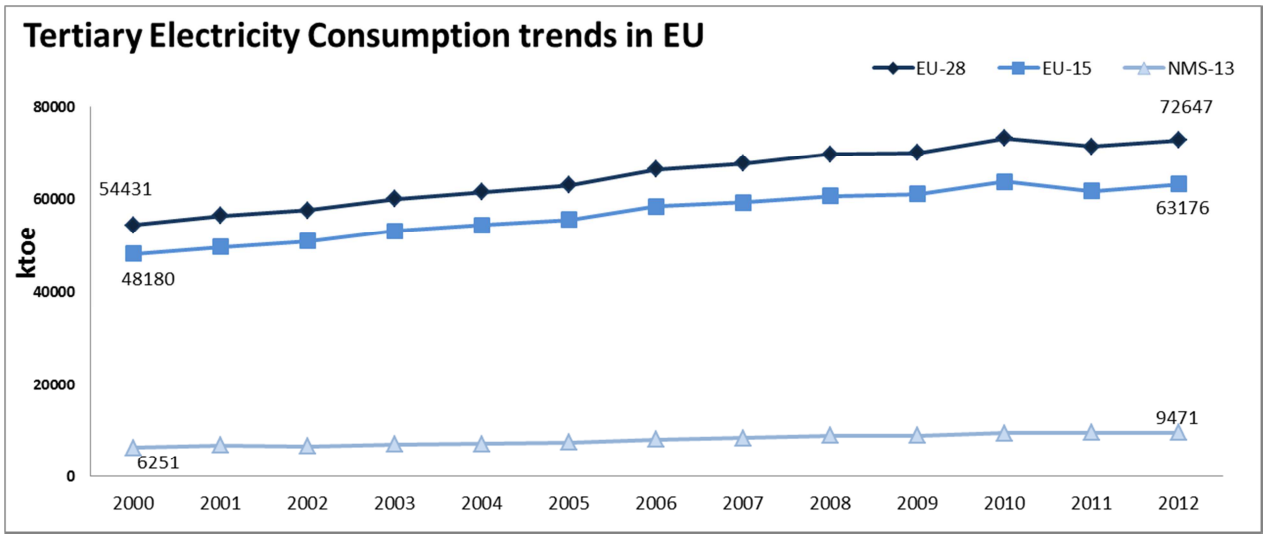
1.

In 2012, the tertiary sector (services in Fig. 107) used 30% of the total electricity consumption, industry used 36% and the residential sector 30%. In the tertiary sector the share of electricity over other energy sources, has become more important as it grew from 46.6% in 2000 to 48.9% in 2012 (Fig. 103) . Electricity consumption in EU-28 grew from 54 Mtoe in 2000, to 72 Mtoe by 2012, a

growth of 33.5% (Fig. 108, Table 10). The growth is more steady compared to the gas consumption (Fig. 108,
Fig. 114), whose annual variations follow those of HDD. In EU-15, electricity consumption was 48 Mtoe in 2000 and grew to 63 Mtoe, representing an increase of 31.1%. For NMS-13 the

growth was even larger, from 6.2 Mtoe in 2000, it reached 9.5 Mtoe by 2012, an increase of 51.5%. This is due to the large growth of the economy in NMS-13. For example the public sector in Servia expanded significantly. Most of the electricity consumption growth happened between 2000-2010. After 2010 there is a small decline, but still the consumption is higher than that of 2009.

Fig. 108 Tertiary electricity consumption trends. Data:Eurostat



From 2000 – 2012, only in the year 2011 there was annual electricity reduction in EU-28. All the other years, electricity consumption was increasing on an annual basis. In 2011 electricity consumption in the tertiary sector dropped, as happened with the final energy tertiary consumption (Fig. 97). However, besides the decline in the final tertiary consumption in 2002 and 2007, electricity consumption did not decline those years. In the NMS-13 there was decline of electricity consumption in 2002, 2009 and 2012. In EU-15 electricity consumption declined only in 2011, however on this year there was growth for NMS-13.

Fig. 109 Tertiary Electricity annual growth Data: Eurostat

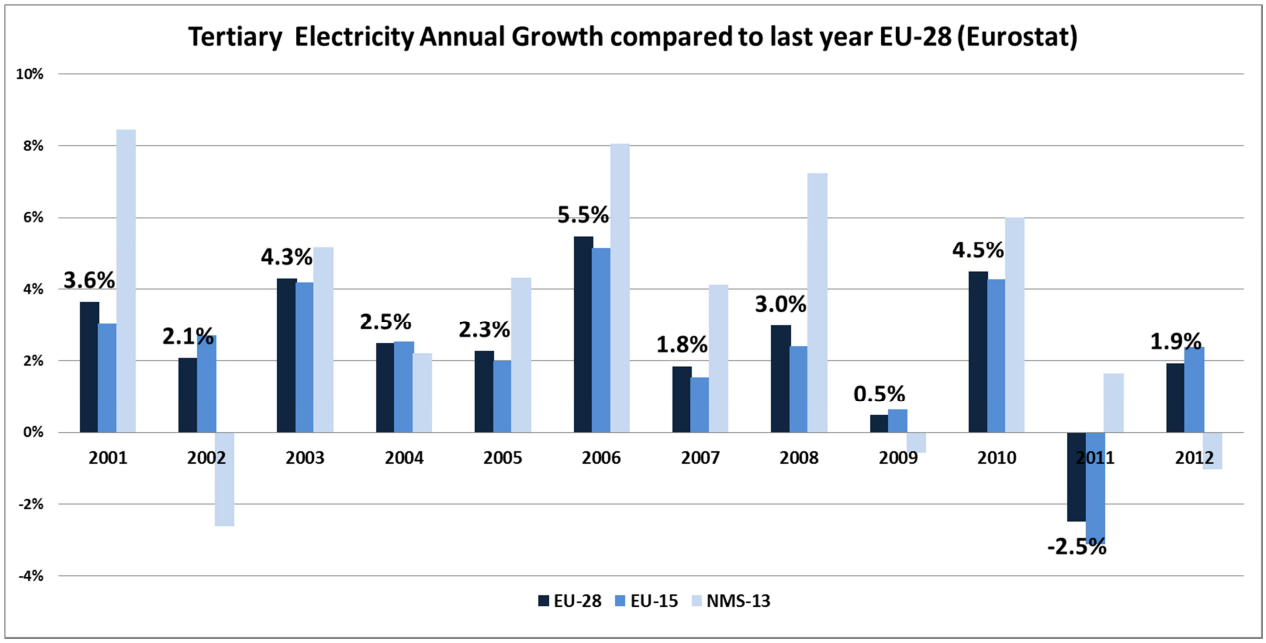


Table 10 Tertiary electricity consumption changes. , Data: Eurostat

% compared to 2000	Tertiary electricity consumption												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	54431	56417	57584	60055	61546	62940	66385	67608	69627	69950	73092	71274	72647
EU-15	48180	49637	50981	53111	54448	55535	58385	59278	60697	61071	63680	61706	63176
NMS-13	6251	6779	6603	6944	7097	7404	8001	8330	8930	8880	9412	9568	9471
% compared to 2000													
% EU 28		3.6%	5.8%	10.3%	13.1%	15.6%	22.0%	24.2%	27.9%	28.5%	34.3%	30.9%	33.5%
% EU 15		3.0%	5.8%	10.2%	13.0%	15.3%	21.2%	23.0%	26.0%	26.8%	32.2%	28.1%	31.1%
% NMS 13*		8.4%	5.6%	11.1%	13.5%	18.4%	28.0%	33.3%	42.9%	42.1%	50.6%	53.1%	51.5%

Fig. 110 Tertiary electricity average annual growth rates in member states. Data: Eurostat.

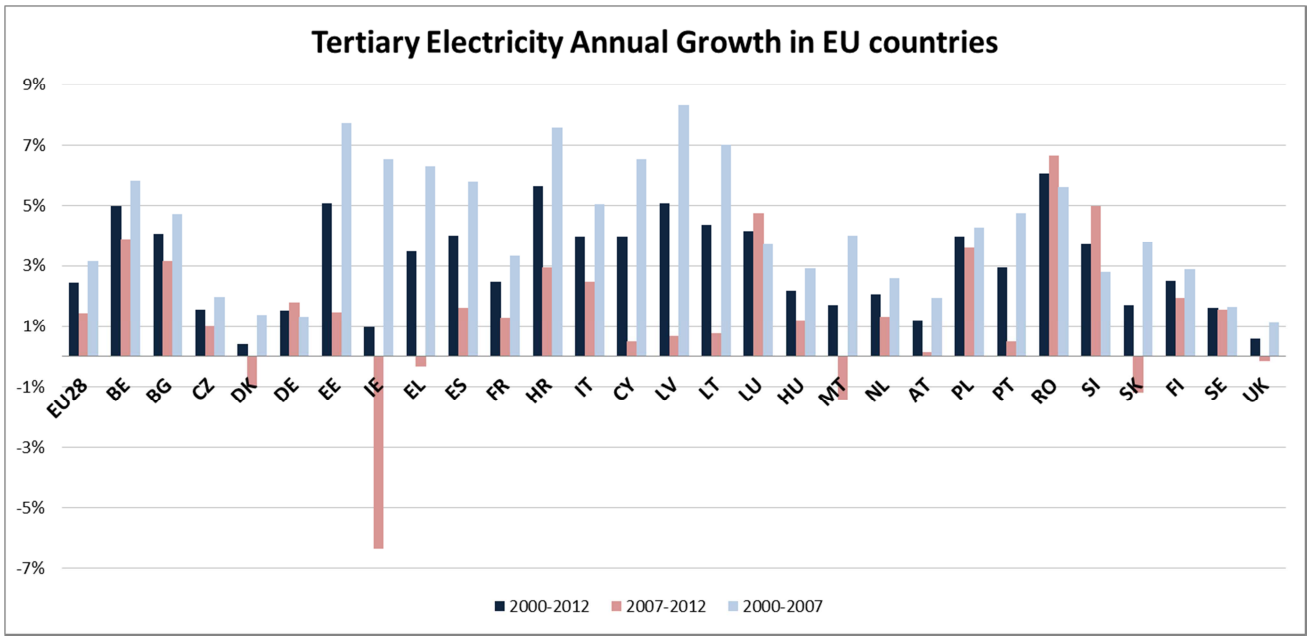


Fig. 110 shows the average annual growth, as it was calculated for different time periods and different member states. In all members states there has been growth of tertiary electricity consumption. In some member states (Denmark, Ireland, Greece, Malta and Slovakia) there was decline for the period 2000-2007, however in all of them, electricity consumption grew for 2007-2012. In the case of Ireland the decline of electricity consumption was around -6% per year from 2000-2007. This is the outcome of economic recession during that period. Denmark Ireland, Austria and UK have some of the lowest growth rates for the period 2000-2012. The highest growth rates are found in Belgium, Estonia, Croatia, Latvia, and Romania.

Fig. 111 shows the electricity consumption per employee, which has increased for EU-28 by 15%. For Finland, Greece and France the electricity consumption per employee has increased as well, however by taking into account the floor area of the tertiary sector for these member states (Fig. 112), it can be seen that electricity consumption per employee and floor area has declined. More specific, in all of the seven member states with available data for floor area, there has been slight decline.

Fig. 111 Tertiary electricity consumption per employee.Data: Odyssee

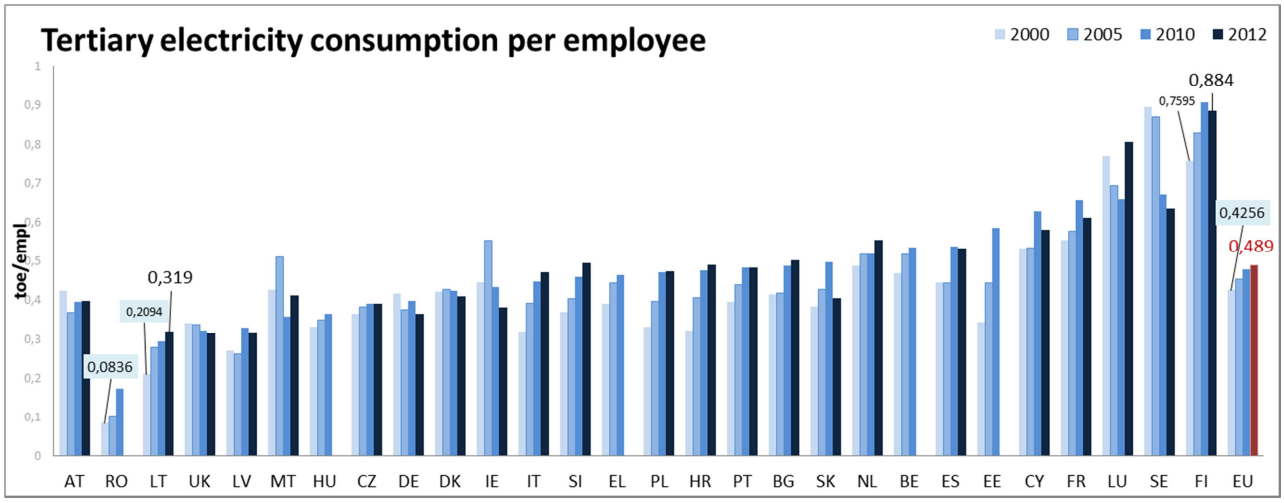
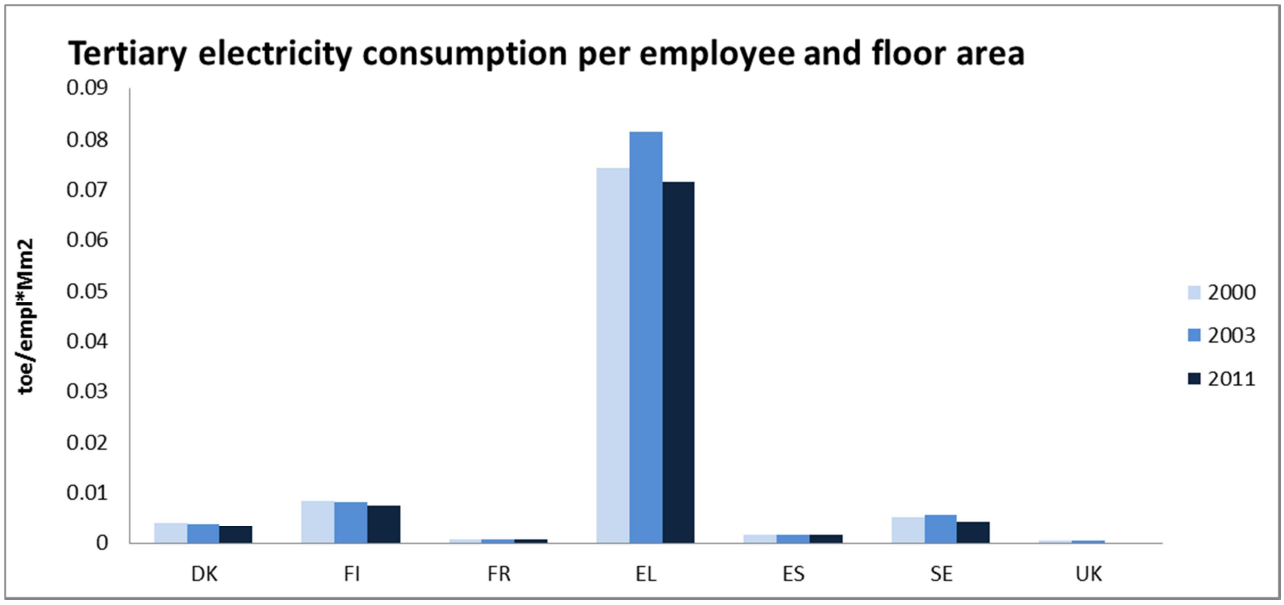
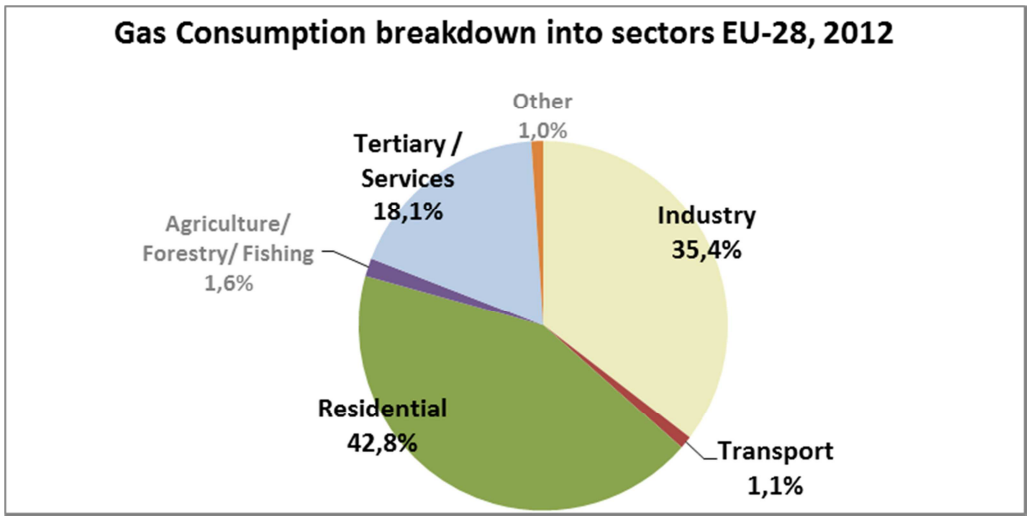


Fig. 112 Tertiary electricity consumption per employee and floor area .Odyssee



Gas Consumption

Fig. 113 Gas breakdown into sectors, 2012. Data: Eurostat



The Tertiary sector has a share of 18.1% of final gas consumption in 2012. Gas consumption has increased considerably since 2000. In EU-28, it was 30 Mtoe in 2000 and by 2012 grew to 46 Mtoe, an increase of 50%. In 2000, gas accounted for 26.1% of total energy consumption in the tertiary sector. This figure grew to 30.7% by 2012. The growth of gas consumption in Mtoe has been much larger in EU-15 where it reached 58% while the growth in NMS-13 was 13.7%. The largest part of the growth took place between 2000-2007 for both EU-15 and NMS-13. In 2007 there is a drop, which could be related to warmer temperatures during that year that could have led to less gas consumption for heating purposes. After 2007, gas consumption rose again and reached a maximum point in 2010[1]

Fig. 114 Tertiary gas consumption trends in EU[17][18] Data: Eurostat

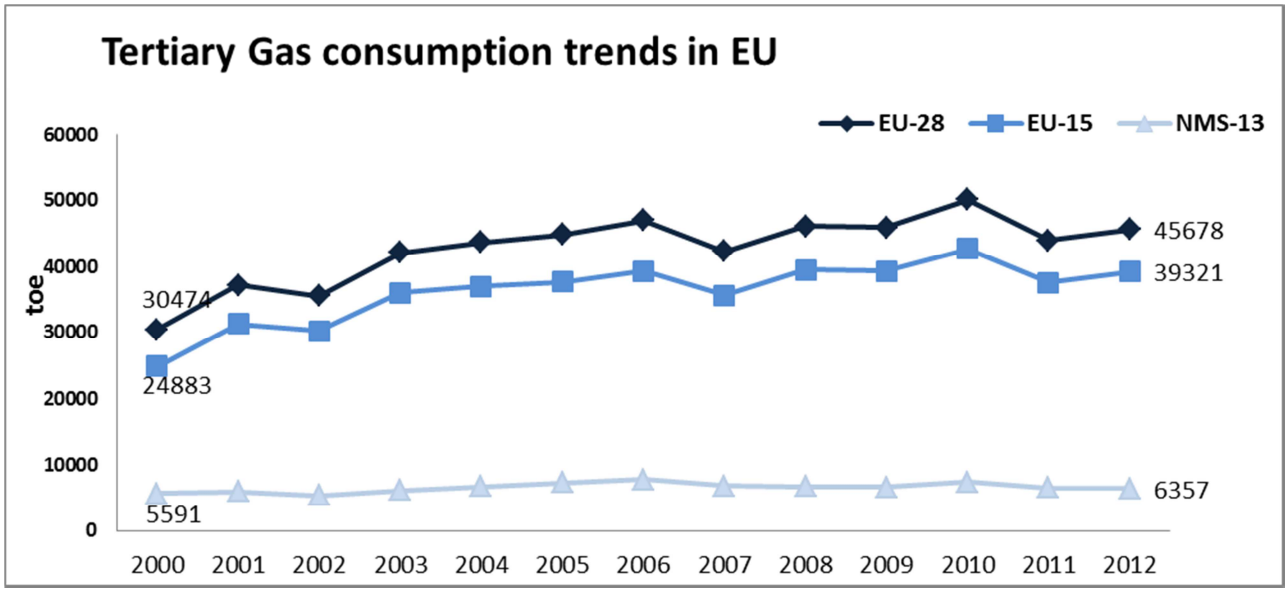
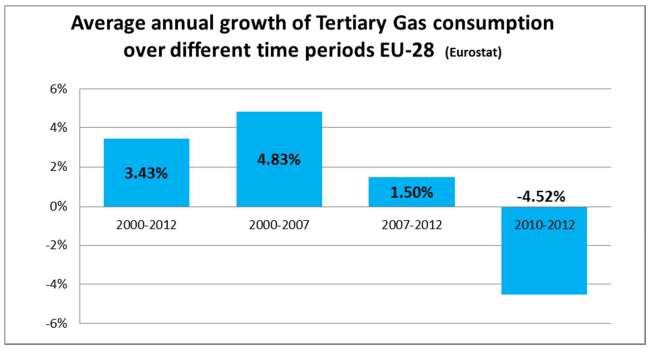
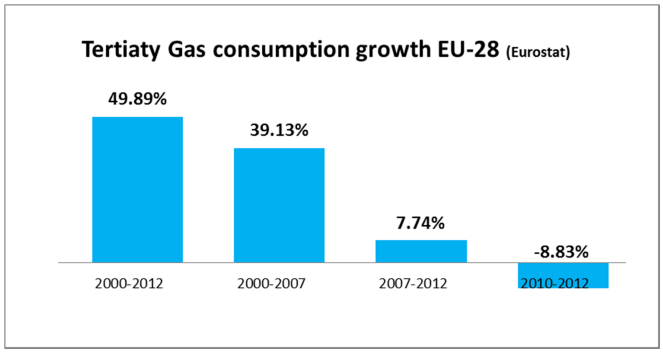


Table 11 Tertiary gas consumption – growth rates. Data: Eurostat

Tertiary gas consumption													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	30474	37197	35606	42141	43718	44942	47053	42397	46189	45954	50100	44031	45678
EU-15	24883	31272	30272	36088	37008	37687	39351	35657	39559	39401	42762	37577	39321
NMS-13	5590.7	5924.8	5333.6	6052.3	6709.7	7254.7	7701.4	6740.5	6629.9	6553.8	7338.5	6454.3	6356.7
% compared to 2000													
% EU 28		22.1%	16.8%	38.3%	43.5%	47.5%	54.4%	39.1%	51.6%	50.8%	64.4%	44.5%	49.9%
% EU 15		25.7%	21.7%	45.0%	48.7%	51.5%	58.1%	43.3%	59.0%	58.3%	71.9%	51.0%	58.0%
% NMS 13*		6.0%	-4.6%	8.3%	20.0%	29.8%	37.8%	20.6%	18.6%	17.2%	31.3%	15.4%	13.7%





The annual growth rates for EU-28 show that there is significant annual variation, which is opposite to the steady growth of electricity consumption.

Fig. 116 shows the average annual growth for different member states and for three different time periods. From 2000 till 2012, gas consumption in the tertiary sector declined in Slovenia, Slovakia, Austria, Hungary and Belgium. Member states with large gas consumption growth include Bulgaria, Greece, Romania, Estonia, Spain and Sweden. It can be seen that for most member states consumption grew more in the period 2000-2007 and after that there was decline.

[17] Gas data are not available for Cyprus and Malta.

Fig. 115 Tertiary gas annual growth Data: Eurostat

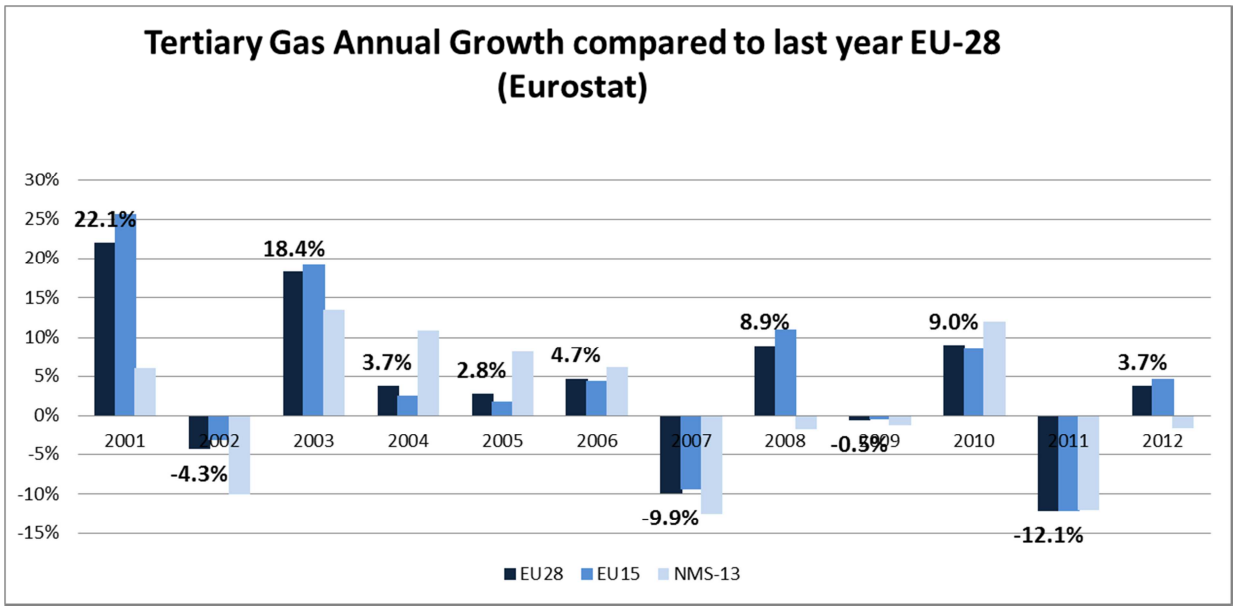
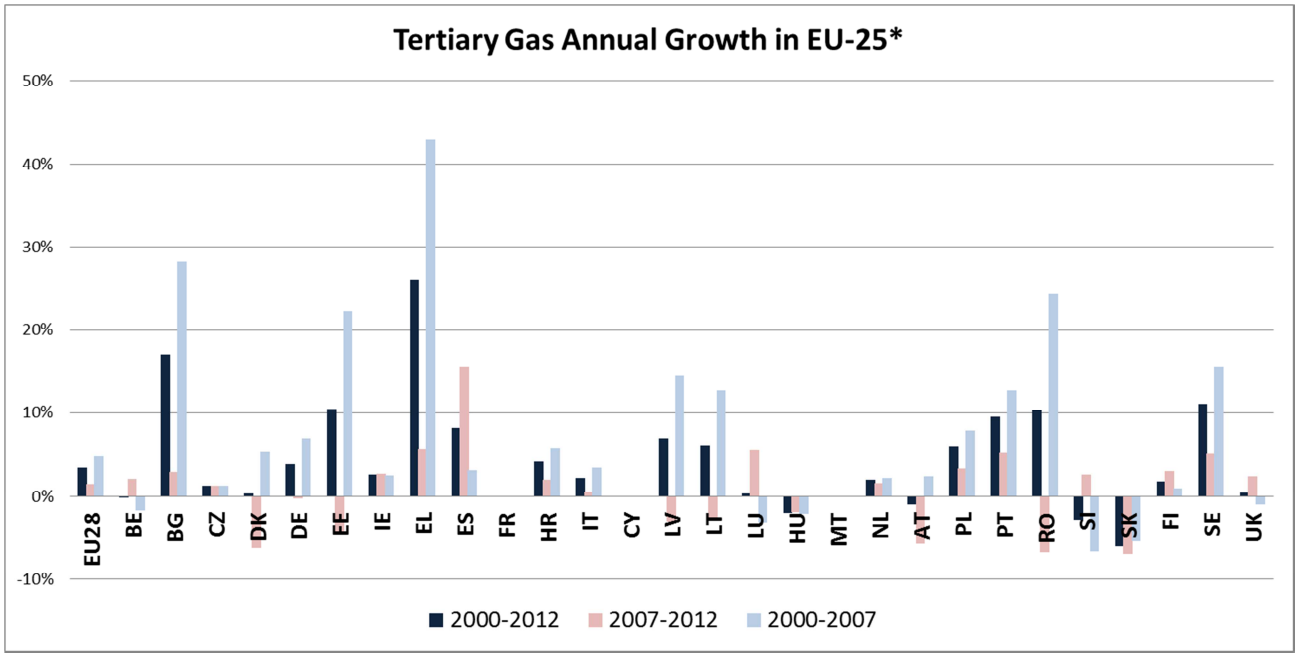


Fig. 116 Tertiary Average annual growth for EU-25 (no data on Cyprus, Malta, France) Data: Eurostat



In 2010, gas consumption per employee in EU-28, was larger than that of 2000. In 2012, however gas consumption per employee is slightly smaller compared to 2000 (by -5.5%). The member states with the largest average growth of gas consumption in

Fig. 116 (Bulgaria, Estonia, Greece, Portugal, Romania and Sweden) experienced also growth in the gas consumption per employee in Fig. 117. In addition, these member states had lower than average

EU gas consumption per employee. Even after the growth, these member states still have lower than average per employee gas consumption.

Slovakia, Hungary and Luxembourg had some of the largest gas consumptions per employee in 2000 and besides experiencing reduction, they still had some of the highest gas consumptions per employee in 2010. The gas consumption per employee and floor area (Fig. 118), shows that there has been growth in Greece, Spain and Sweden and stability or slight decline for Denmark, Finland, France, Germany and UK.

Fig. 117 Tertiary gas consumption per employee Data: Odyssee

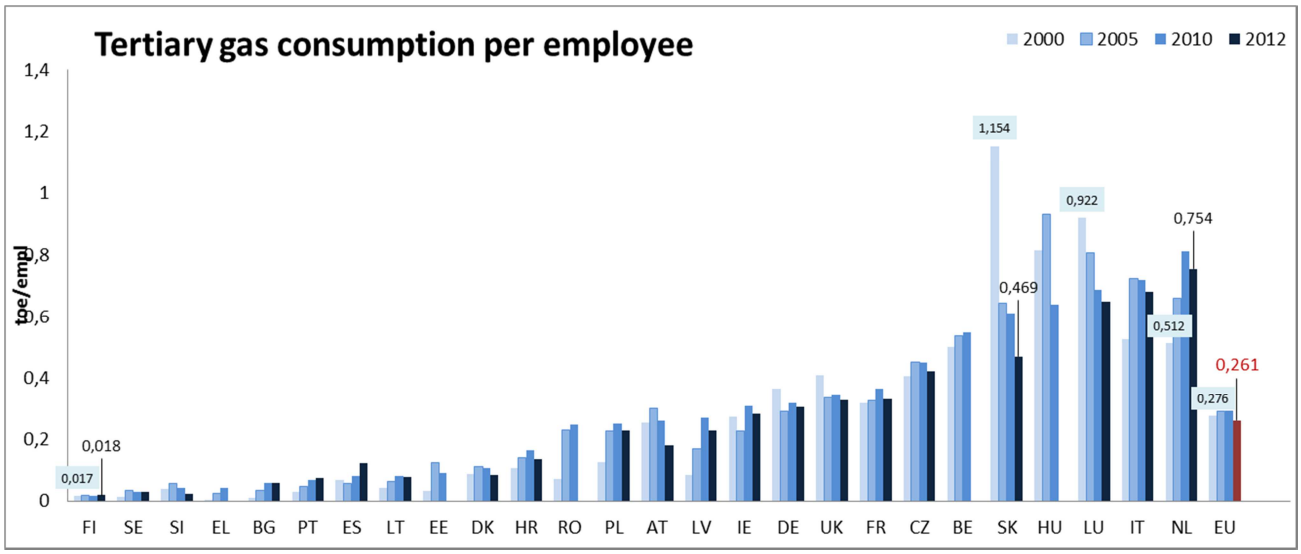
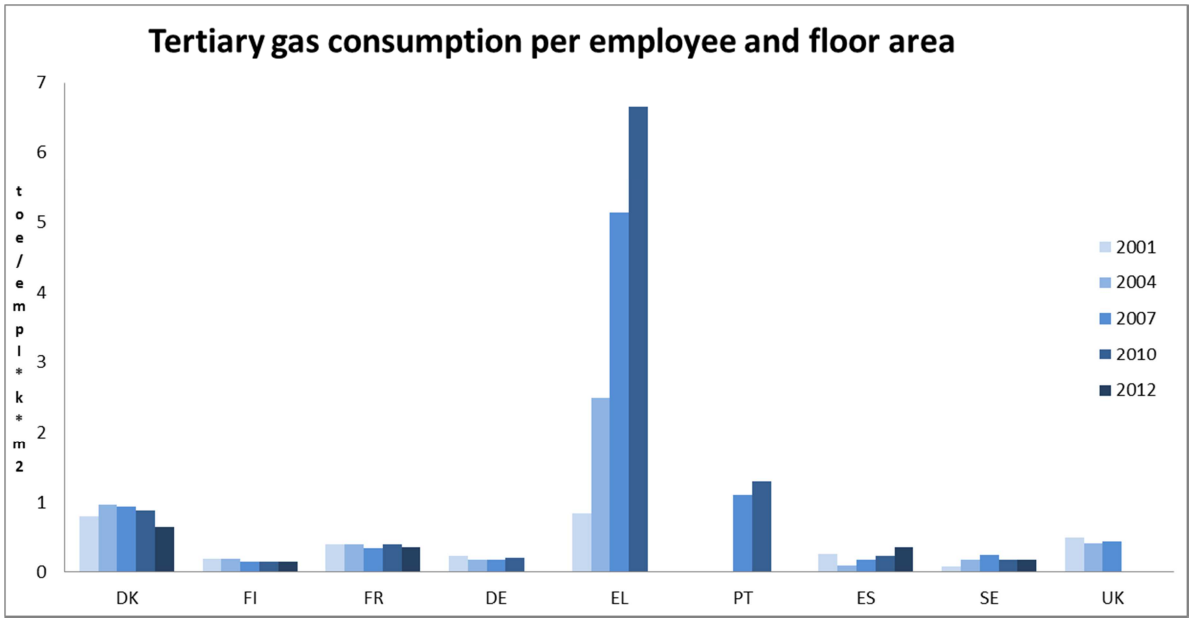


Fig. 118 Tertiary gas consumption per employee and floor area. Data: Eurostat



Overview-Tertiary Sector

The Tertiary sector although consumes the smallest amount of energy compared to the other sectors, is very important due to the large amount of GVA that it generates. Tertiary energy consumption in EU-28 has grown by 27% from 2000-2012. However energy consumption by GVA has declined by 13%, something that indicates improvements in energy efficiency.

The energy consumption per employee has slightly increased in EU-28. However when looking into individual member states the situation is very diverse. In around half of the member states the energy consumption per employee has declined, while in the other half the consumption has become larger. Floor area is also important, as it seems that in some member states besides the growth in the energy consumption per employee, there was decline in the energy consumption per employee and per floor area.

The main energy fuel in the tertiary sector is electricity which provides 49% of the energy demands and second in importance is gas, which provides 31% of the final energy consumption. From 2000 onwards, there has been growth of the energy provided by gas, derived heat, electricity and renewables, while solid fuels and total petroleum products have been on decline. Tertiary electricity consumption has grown by 34% in EU-28. In NMS-13 the total growth was higher than that of EU-15. The growth has been gradual in a yearly basis with the exception of 2011, when there was a decline of electricity consumption compared to the previous year. All the member states have experienced growth of electricity consumption for 2000-2012. Electricity consumption per employee grew also in EU-28, however when taking the floor area into account for a small sample of member states, it can be seen that the growth was less. Tertiary gas consumption grew by 50%. In EU-15 the growth reached 58% while in NMS-13 it was much less, only 14%. Gas consumption per employee in EU-28 has slightly reduced compared to 2000. Gas is increasingly becoming more important although it is the second energy source after electricity. In some member states, gas consumption has dropped. Electricity consumption is growing more gradually, while in contrast to gas, electricity has grown in all member states.

4. Transport Sector

Transport final energy consumption in EU-28 rose from 345 Mtoe in 2000 to 352 Mtoe in 2012. That is an increase of 1.9%. However, transport final energy consumption had reached a maximum of 383 Mtoe in 2007, which was an increase of 11% compared to 2000. From 2000 till 2007 there was a constant growth of the consumed energy on an annual basis while after 2007 there was constant decline. The decline was more sudden in 2009 where the energy consumption in the transport sector dropped by 3.5% in just one year. This is probably related to the financial and economic crisis. For comparison the total final energy of all sectors dropped by 5.7% the same year. In 2012 the energy consumption in the transport sector dropped by 2.8% compared to 2011. For NMS-13 the growth of transport energy consumption in 2000-2012 was very large. From 31 Mtoe in 2000, consumption reached 49 Mtoe in 2008, a total growth of 57.3%. However after 2008, there was a stop of the rapid growth trends. In 2009 there was an annual decline of 3%, while in 2012 there was a decline of 2.5% compared to the year before. In total, transport energy consumption from 2000 to 2012 grew by 51.2% in NMS-13 and declined by 2.9 % in EU-15.

Fig. 119 Transport energy consumption, Data: Eurostat

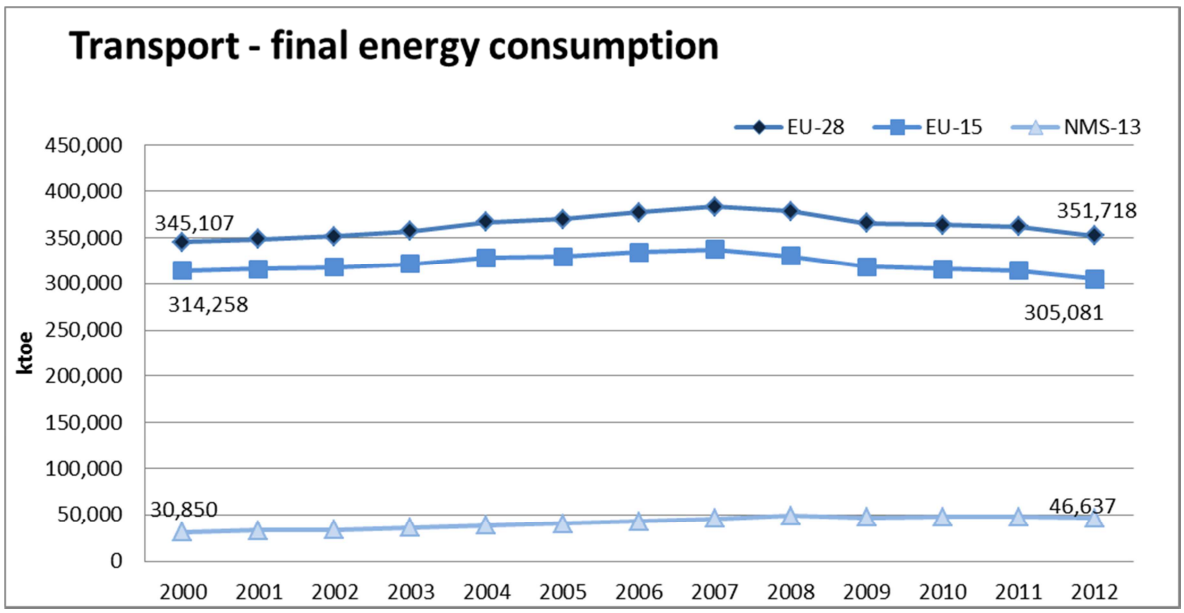


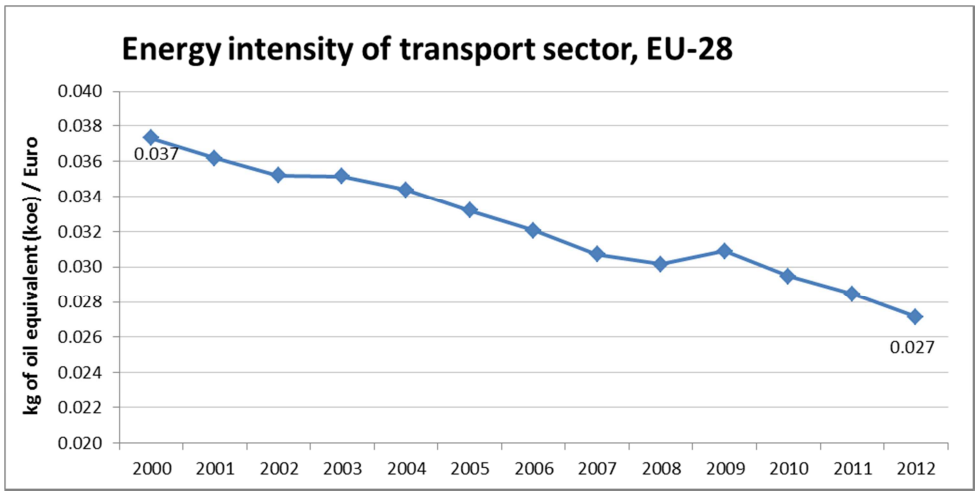
Table 12 Transport final energy consumption-growth rates. Data: Eurostat

Transport Final Energy Consumption													
(ktoe)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	345107	348465	351381	356867	366406	369568	377059	382986	378408	365242	363666	361855	351718
EU-15	314258	315578	317807	321123	328145	329221	334190	336995	329876	318181	316138	314005	305081
NMS-13	30850	32887	33574	35744	38261	40347	42869	45990	48532	47061	47528	47851	46637
% Change from 2000													
% EU 28		1.0%	1.8%	3.4%	6.2%	7.1%	9.3%	11.0%	9.6%	5.8%	5.4%	4.9%	1.9%
% EU 15		0.4%	1.1%	2.2%	4.4%	4.8%	6.3%	7.2%	5.0%	1.2%	0.6%	**-0.1%**	**-2.9%**
% NMS 13*		6.6%	8.8%	15.9%	24.0%	30.8%	39.0%	49.1%	57.3%	52.6%	54.1%	55.1%	51.2%
% Annual change													
% EU 28		1.0%	0.8%	1.6%	2.7%	0.9%	2.0%	1.6%	**-1.2%**	**-3.5%**	**-0.4%**	**-0.5%**	**-2.8%**
% EU 15		0.4%	0.7%	1.0%	2.2%	0.3%	1.5%	0.8%	**-2.1%**	**-3.5%**	**-0.6%**	**-0.7%**	**-2.8%**
% NMS 13*		6.6%	2.1%	6.5%	7.0%	5.5%	6.3%	7.3%	5.5%	**-3.0%**	1.0%	0.7%	**-2.5%**

Energy intensity

The energy intensity of the transport sector shows the ratio of the total energy consumption in the transport sector to the total GDP in EU-28. The energy intensity changes from 0.037 koe/Euro in 2000 to 0.027 koe/Euro in 2012, a total decline of 27.3%. This decline was constant with the exception of 2009, when there was significant GDP decline due to the economic and financial crisis.

Fig. 120 Energy Intensity of transport sector. Data: Odyssee



Energy Sources

The majority of the energy consumption in transport comes from the different oil products. Oil (all products) accounts for 93.9% of the total energy sources in 2012. In 2000, it accounted for 97.6%, which shows that there has been a slight decline in its share. The share of electricity has declined slightly as well from 2.2% in 2000 to 1.9% in 2012. The share of biofuels in total energy mix has increased significantly from 0.2% to 4.1%. Biofuel consumption in actual numbers grew from only 710 ktoe in 2000 to 14,601 ktoe in 2012 which is a growth of 1956%.

Fig. 121 Energy sources of transport, EU-28, Data: Odyssee.

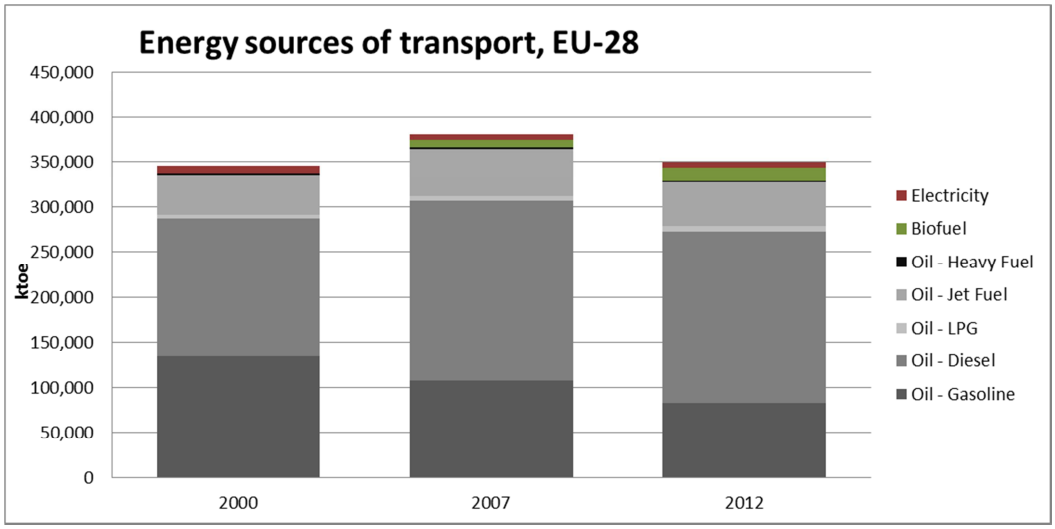


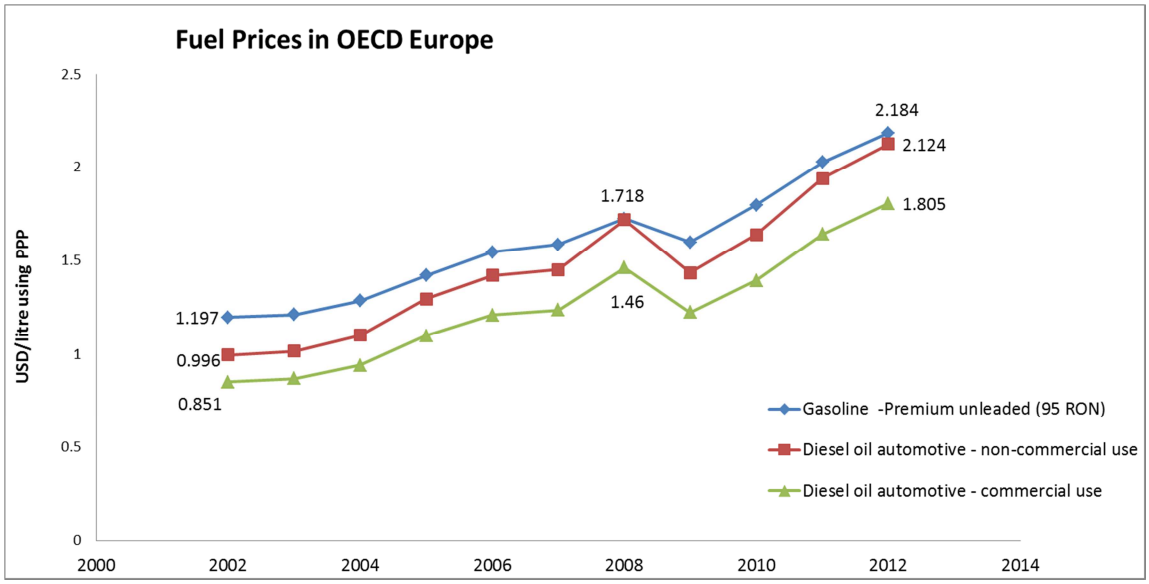
Table 13 Shares of energy sources to total transport energy consumption, EU-28 Data: Odyssee

Transport energy consumption		2000	2007	2012
Ktoe	**Oil (total)**	337,373	367,023	328,800
	Biofuels	710	7,686	14,601
	Electricity	7,709	6,558	6,661
	Total	345,792	381,267	350,062
Share % in total energy mix	Oil (total)	97.6%	96.3%	93.9%
	Biofuels	0.2%	2.0%	4.2%
	Electricity	2.2%	1.7%	1.9%

Fuel Prices

Diesel and gasoline prices have been increasing from 2002 onwards. There was a drop in 2009 but prices continued rising from 2010. Gasoline prices were higher than diesel oil for non-commercial use. However the price difference between gasoline and diesel oil has become smaller in 2012. Compared to 2002 gasoline price rose by 83%, diesel oil for non-commercial use rose by 113% and diesel oil for commercial use rose by 112%.

Fig. 122 Fuel prices – OECD Europe. Data: IEA.



2.

Transport Subsectors

From the different transportation modes, road transport has the largest energy consumption. In 2012 it consumed 288 Mtoe which was 81.8% of the total transport energy consumption. In 2000 it consumed 4 Mtoe less. Although the energy consumption in 2012 was larger, the share of road consumption to the total declined by 1% (Table 14). This is due to the increase of consumption in other sectors such as international aviation and pipeline transport. Other transport modes whose share over the total mix has dropped include rail, domestic aviation and domestic navigation.

Fig. 123 Energy consumption in different transport subsectors[19]. Data: Eurostat

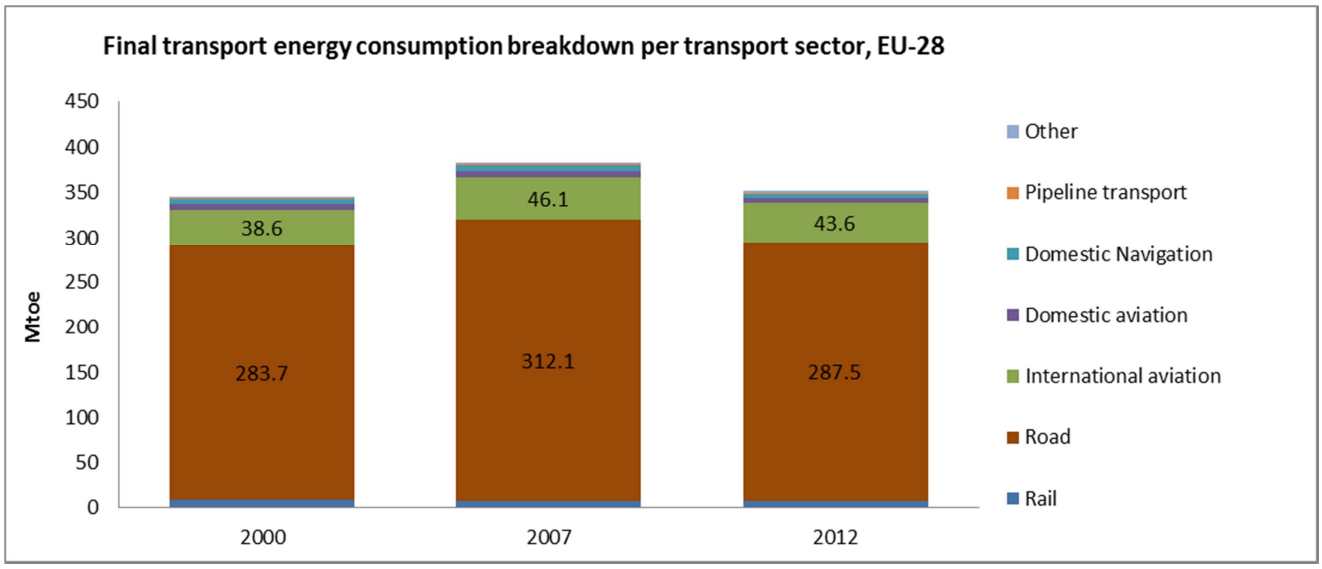


Table 14 Energy consumption in different transport subsector-Shares to total and growth rates. Data: Eurostat

Consumption per sector (ktoe)	2000		2007		2012		growth from 2000-2012
	ktoe	%	ktoe	%	ktoe	%	
Rail	8,170	2.4%	7,503	2.0%	6,994	2.0%	-14.4%
Road	283,686	82.2%	312,071	81.5%	287,543	81.8%	1.4%
International aviation	38,633	11.2%	46,140	12.0%	43,615	12.4%	12.9%
Domestic aviation	6,342	1.8%	7,074	1.8%	5,510	1.6%	-13.1%
Domestic Navigation	6,123	1.8%	6,972	1.8%	4,426	1.3%	-27.7%
Pipeline transport	532	0.2%	1,998	0.5%	1,432	0.4%	169.0%
Other	1,621	0.5%	1,228	0.3%	2,198	0.6%	35.6%
Total	345,107	100%	382,986	100%	351,718	100%	1.9%

[19] Domestic Navigation includes inland waterways.

Fig. 124 shows the energy sources for different transport sectors. Road transport depends mainly on oil by 94.5% and on biofuels by 5%. Rail transport depends mainly on electricity by 59.9% and on oil for 39.7%. Aviation depends 100% on oil and pipeline transport on gas.

Fig. 124 Energy sources per transport sector, Data: Eurostat

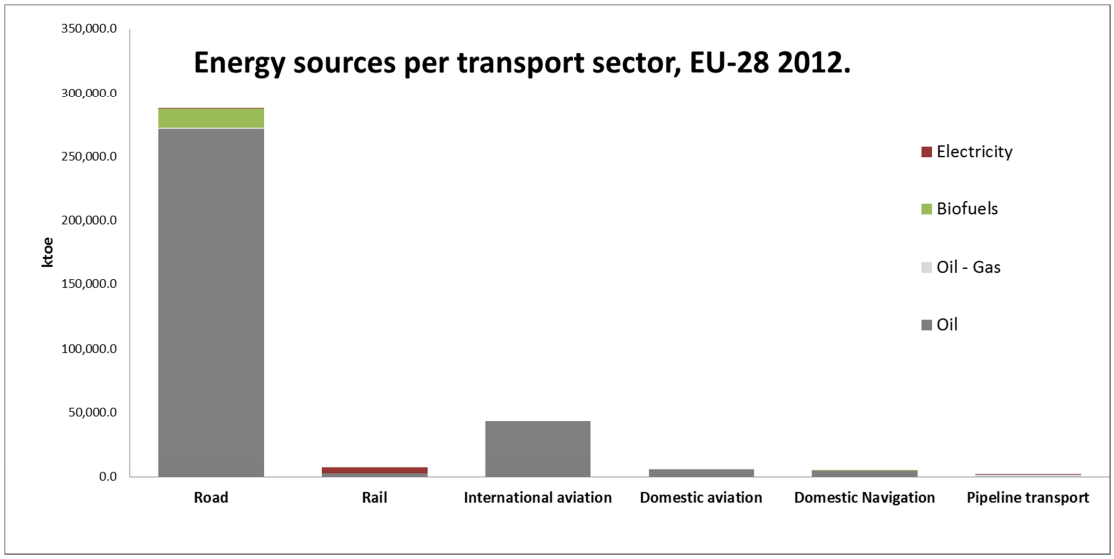


Table 15 Energy sources per transport sector, Data: Eurostat

% of energy source for each sector	Oil	Oil - Gas	Biofuels	Electricity
Road	94.5%	0.5%	5.0%	0.0%
Rail	39.7%	0.0%	0.4%	59.9%
International aviation	100.0%	0.0%	0.0%	0.0%
Domestic aviation	100.0%	0.0%	0.0%	0.0%
Domestic Navigation	99.9%	0.0%	0.1%	0.0%
Pipeline transport	0.1%	93.0%	0.0%	6.9%
Other	38.7%	5.8%	3.0%	52.5%

Because of the importance of road transport, it is interesting to know how its energy sources have evolved in time. The large majority (around 98%) of road fuels in 2000 are gasoline and diesel, with gasoline providing the 47% of needed energy and diesel the 51% (

Fig. 125). By 2012, gasoline consumption had declined from 134 Mtoe in 2000 to 82 Mtoe. Diesel consumption increased significantly from 145 Mtoe to 184 Mtoe for the same period, a total change of +39 Mtoe. Biofuels (bioethanol and biodiesel) also increased by 14 Mtoe from 2000-2012. Although the share of biofuels to the total road consumption is around 5%, their combined growth is around 1943%. In total gasoline consumption is the only energy source that has declined while in the other energy sources, there has been significant growth.

Fig. 125 Energy sources of road energy consumption, EU-28 Data: Odyssee

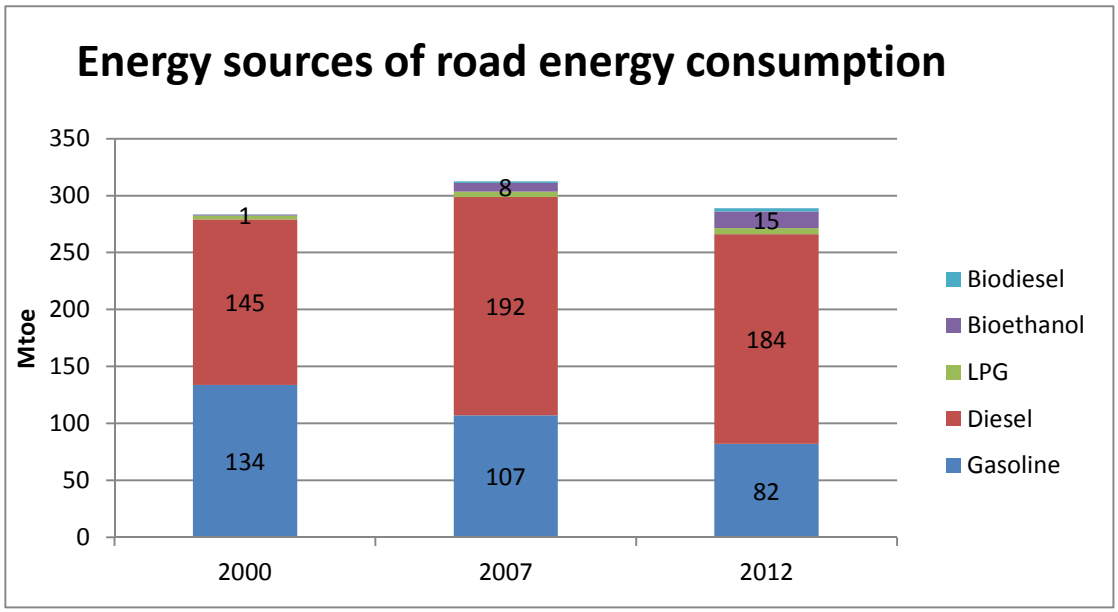


Table 16 Road consumption per energy source Data: Odyssee

Road consumption per energy source	Mtoe			% to total			% growth
	2000	2007	2012	2000	2007	2012	2000-2012
Oil - Gasoline	133.79	107.16	82.03	47%	34%	29%	-39%
Oil - Diesel	145.20	191.54	184.23	51%	62%	64%	27%
Oil - LPG	3.60	4.84	5.35	1%	2%	2%	49%
Bioethanol	0.06	1.18	2.85	0%	0%	1%	4796%
Biodiesel	0.65	6.48	11.55	0%	2%	4%	1673%

Road sector

The different vehicles on road transport are cars, vehicles with two wheels, busses, trucks and other light vehicles. Cars are the main energy consumer of the road sector (

Fig. 126). In 2000, 169 Mtoe was consumed by cars, which accounted for 60% of the total road energy consumption. By 2012 car consumption slightly declined to 166 Mtoe and the share of car consumption over the total dropped to 58%. Cars are the only vehicle whose total consumption declined since 2000. The rest of the vehicles increased their total energy consumption. The category with the most growth are the trucks and light vehicles whose consumption rose by 4 Mtoe.

Fig. 126 Energy consumption per vehicle,EU-28 Data: Odyssee

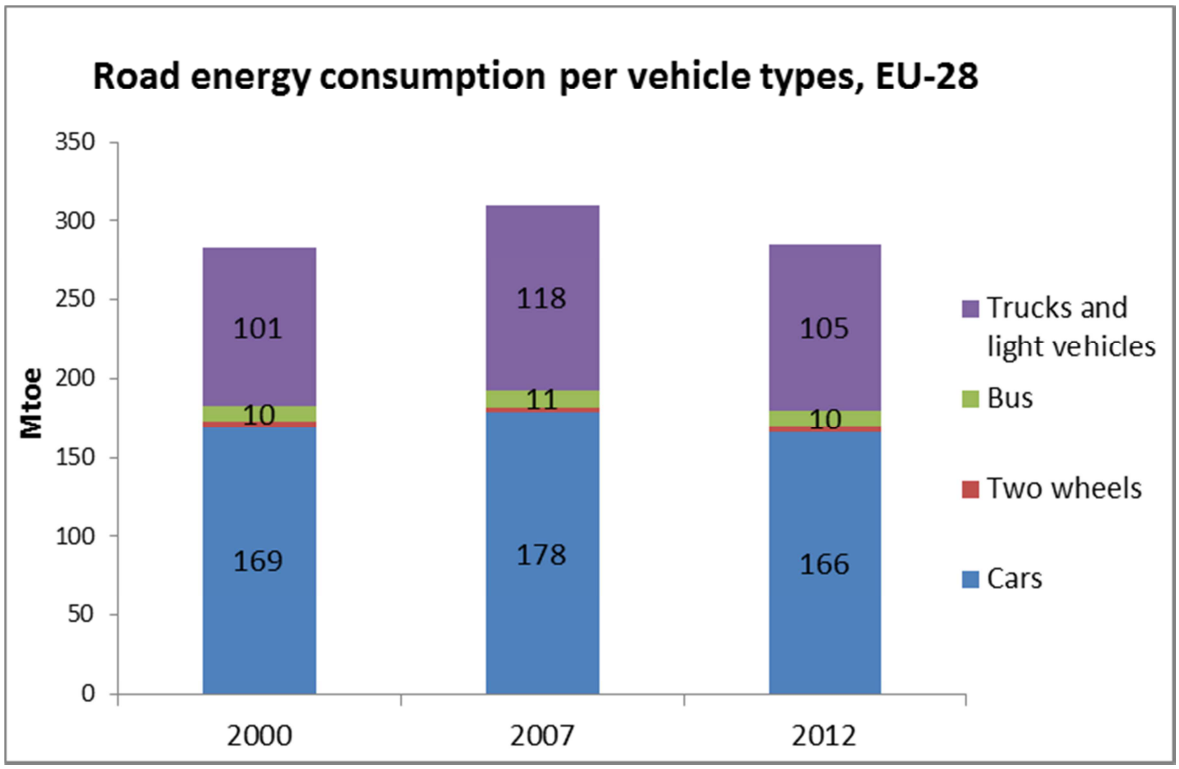


Table 17 Energy consumption per vehicle-growth rates. EU-28 Data: Odyssee

Energy consumption per vehicle type	Mtoe			% to total			% growth 2000-2012	Change in Mt 2000-2012
	2000	2007	2012	2000	2007	2012		
Trucks and light vehicles	100.62	117.50	104.74	35.6%	37.9%	36.8%	4%	4.12
Bus	9.61	10.58	10.20	3.4%	3.4%	3.6%	6%	0.60
Two wheels	3.27	3.76	3.80	1.2%	1.2%	1.3%	16%	0.53
Cars	169.36	178.28	166.16	59.9%	57.5%	58.3%	-2%	-3.20

Due to the changes in the distribution of energy per vehicle type, it is important to see whether there have been any changes in the stock of vehicles. In 2012 the total number of vehicles was 305.3 million instead of 247.1 million in 2000. This is an increase of 23.5%. Although most of this growth in actual numbers can be attributed to cars, which rose by 22.2%, motorcycles and trucks increased significantly compared to their initial small numbers (by 29.6% and 27.9% respectively). In total the share of each type of vehicles to the total has not changed significantly from 2000 to 2012. However it is interesting to note that besides the -2% energy reduction in the total car energy consumption, the number of cars rose by 22.2%.

Fig. 127 Number of vehicles in EU-28. Data: Odyssee

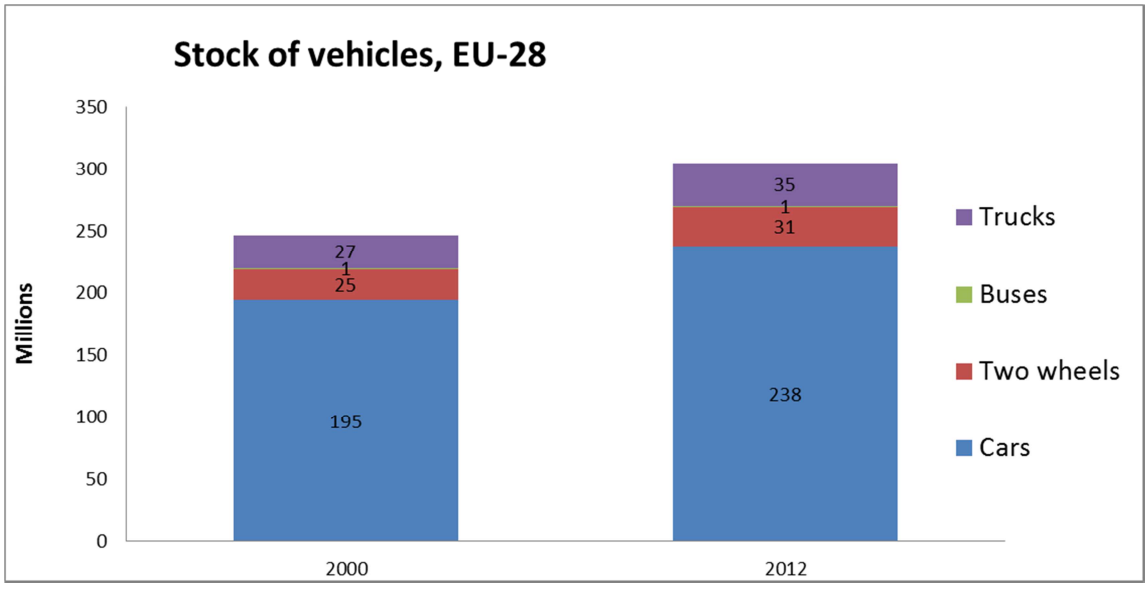


Table 18 Number of vehicles in EU-28- growth rates Data: Odyssee

Millions	2000	2012	% growth (2000-2012)	Growth in million	Share in total % 2000	Share in total % 2012
Trucks	26.8	34.7	29.6%	7.92	10.8%	11.4%
Buses	0.8	0.8	2.2%	0.02	0.3%	0.3%
Two wheel veh.	24.6	31.5	27.9%	6.88	10.0%	10.3%
Cars	194.9	238.2	22.2%	43.31	78.9%	78.0%
Sum	247.1	305.3	23.5%	58.13	100%	100%

Fig. 128 shows the energy consumption per individual vehicle by taking into account the total vehicle stock and the total energy consumption per vehicle type. In cars and trucks, there has been significant reduction -19.7% in the energy consumption divided by vehicle stock. This could have other explanations besides improved efficiency, such as reduction in the average km travelled. In two-wheel vehicles, there has been a reduction of -10%. Bus, is the only vehicle type that consumed more energy per vehicle. This could indicate a shift from cars to busses as a means of transport, or increased energy consumption per bus for other reasons.

Fig. 128 Total transport energy consumption divided by type of vehicle.Data: Odyssee

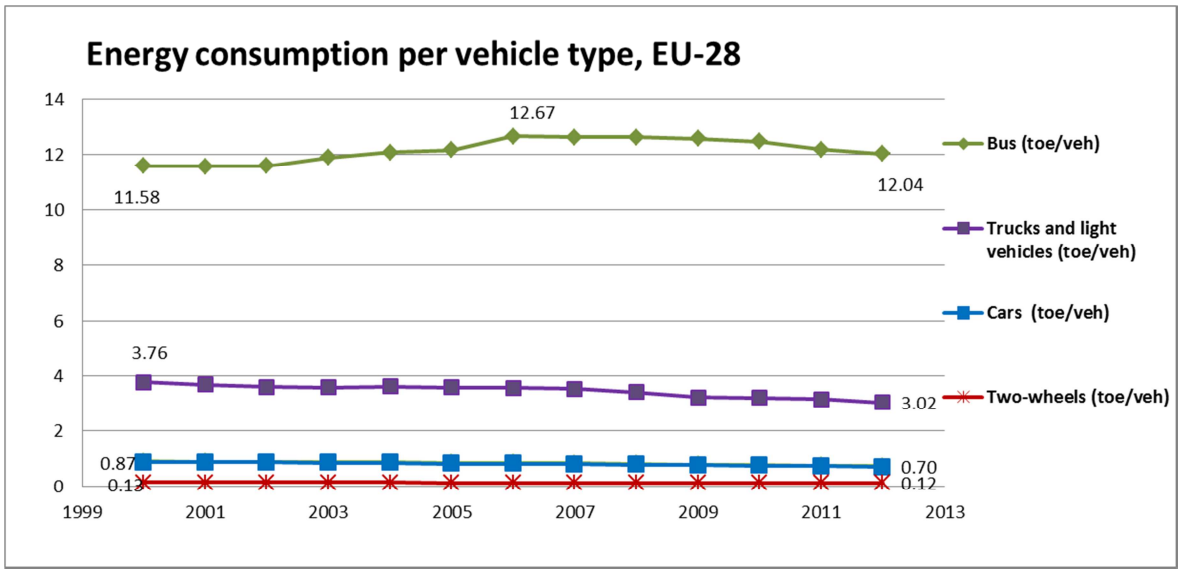
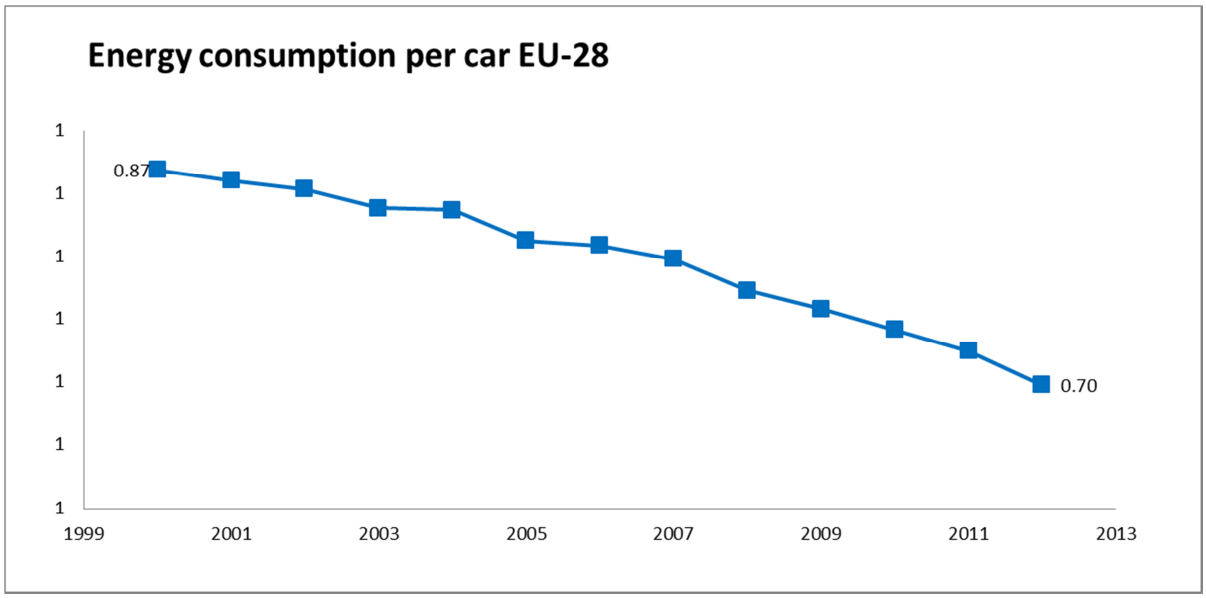


Table 19 Total transport energy consumption divided by type of vehicle-growth rates.Data: Odyssee

toe/veh	2000	2012	growth (toe/veh)	% 2000-2012
Bus	11.5789	12.0354	0.4565	3.9%
Trucks and light vehicles	3.7576	3.0189	-0.7387	-19.7%
Cars	0.8689	0.6975	-0.1714	-19.7%
Two-wheels	0.133	0.1207	-0.0123	-9.2%

Road sector - Cars

Fig. 129 Energy consumption per car. Data: Odyssee



The total annual distance travelled by cars has declined from 13,076 km in 2000 to 12,111km in 2012, a decline of 7.4%. It can be seen that the decline has followed a steady rhythm from 2008 to 2012. For this period, the annual change ranges from 2.2% reduction in 2008 to 0.6% reduction in 2012.

Fig. 130 Annual distance travelled by cars, EU-28. Data: Odyssee

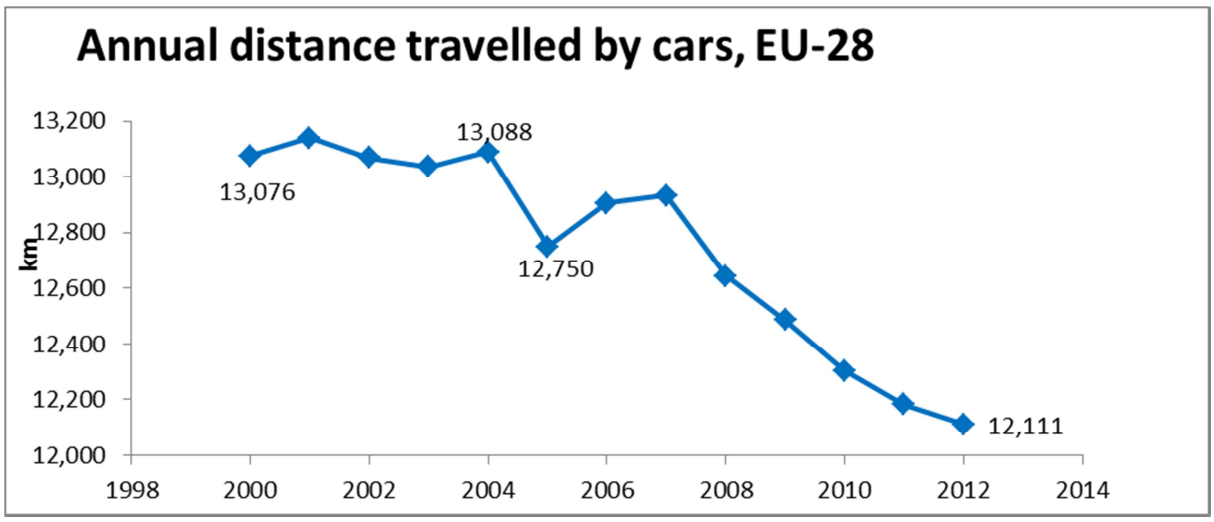
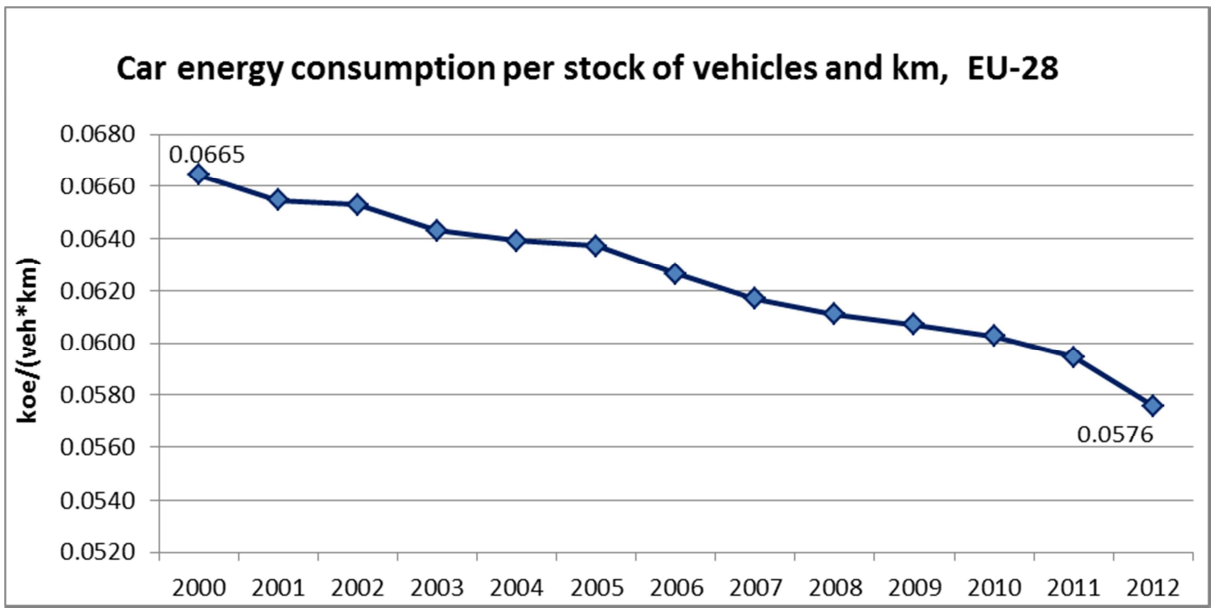


Fig. 131 shows the total car energy consumption per stock of cars and per average annual distance in EU-28. There has been a total reduction of -13.3% of this indicator which shows that energy consumption has still declined by taking into account the total travelled km and number of vehicles.

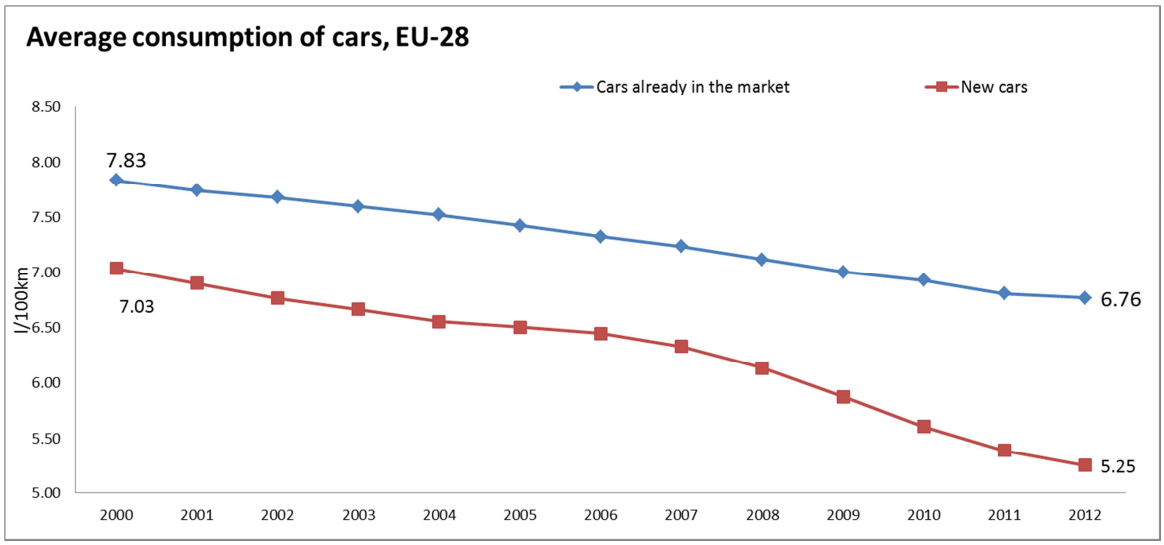
Factors that could be related to this reduction are: use of cars in speeds that give maximum consumption efficiency, less traffic congestion, using smaller or more efficient cars.

Fig. 131 Car energy consumption per number of vehicles and number of km. Data: Odyssee



The average specific consumption of cars shows the consumption of one car in litres per 100 km. It is calculated from the total consumption of cars, stock of cars and average distance travelled by car per year. The average consumption of new cars is calculated from fuel consumption tests[20]. In both cases there is an ongoing decline since 2000. In total, the average consumption of cars in the market has declined by -13.6% while the consumption of new cars entering the market is even larger at 25.3%. It can be seen also that after 2007 the rate of decline in the consumption of new cars has increased.

Fig. 132 Average specific consumption of new and existing cars. Data: Odyssee



[20] Definition of energy efficiency Indicators in Odyssee database

Although the annual distance travelled by cars is decreasing, the number of cars per 1000 inhabitants is increasing. In 2000 there were 361 cars per 1000 inhabitants, while by 2011 there were 450 cars per inhabitant (

Fig. 133). This is a total growth of 24.5%. This means that there are more cars in the market that are used for shorter distances.

Fig. 133 Passenger cars per 1000 inhabitants, [21]Data: Eurostat

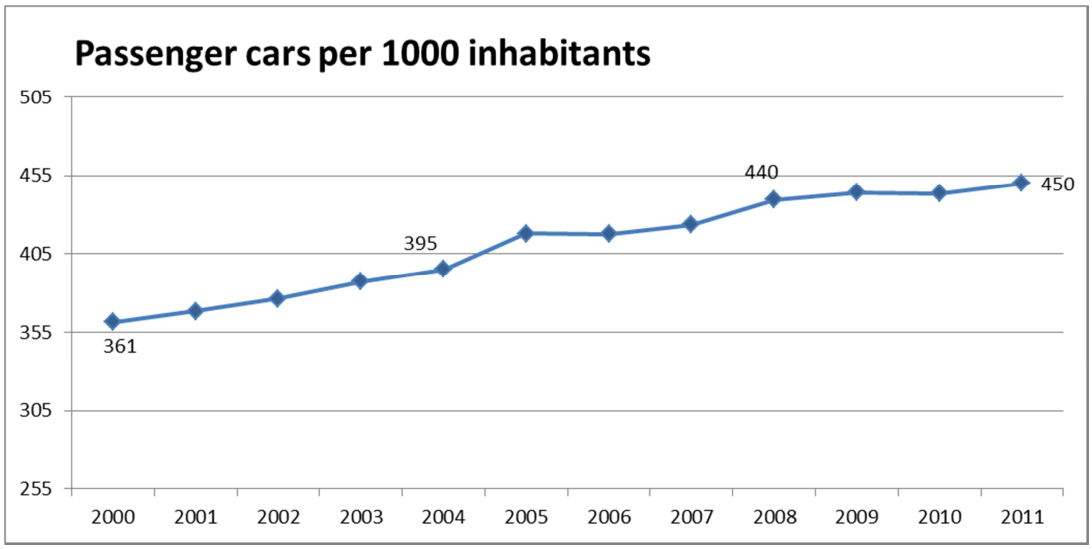


Table 20 Overview of changes in Transport Sector and Road Sector.

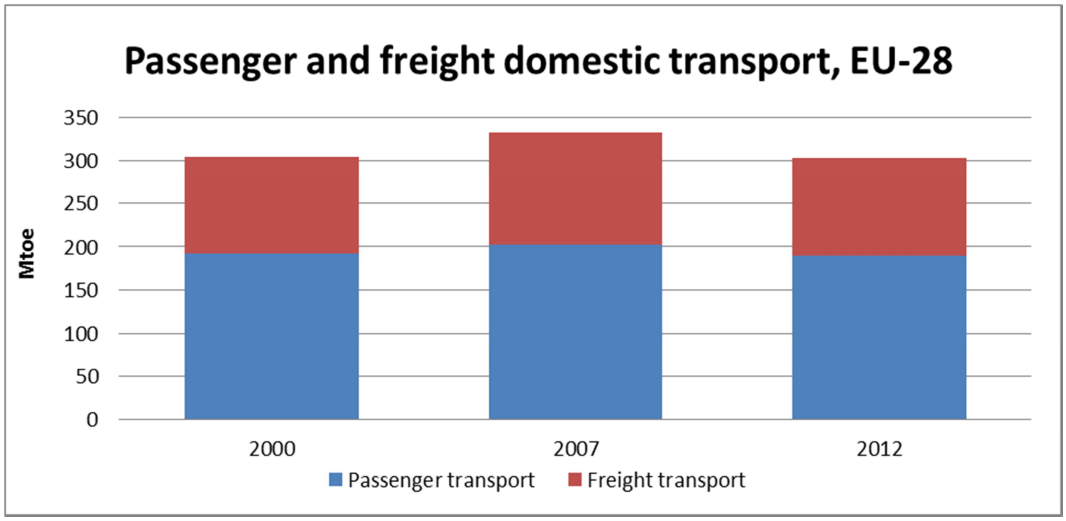
Transport Sector	% 2000-2012	**Road Sector:**	% 2000-2012
Final Transport consumption (Mtoe)	2%	Cars -consumption (Mtoe)	-2%
Energy Intensity (Mtoe/GDP)	-27%	Number of cars	22%
Fuel prices (2002-2012)	83%-113%	Consumption per car(toe/veh)	-20%
		Distance travelled	-7%
		Car (Mtoe) / Stock*km	-13%
		New Car (Mtoe) / Stock*km	-25%
		Stock of cars per 1000 inhabitar	24%

Passenger and Freight Transport

Most of the energy used in the transport sector is for domestic transportation, which can be divided into passenger and freight transport. Passenger transport accounts for the 63% of the domestic transport and freight transport for 36%. The share of passenger transport over the total declined slightly from 63.17% in 2000 to 62.51% in 2012.

[21] Data are not available for DK, EL, FR, LU, AT, PT

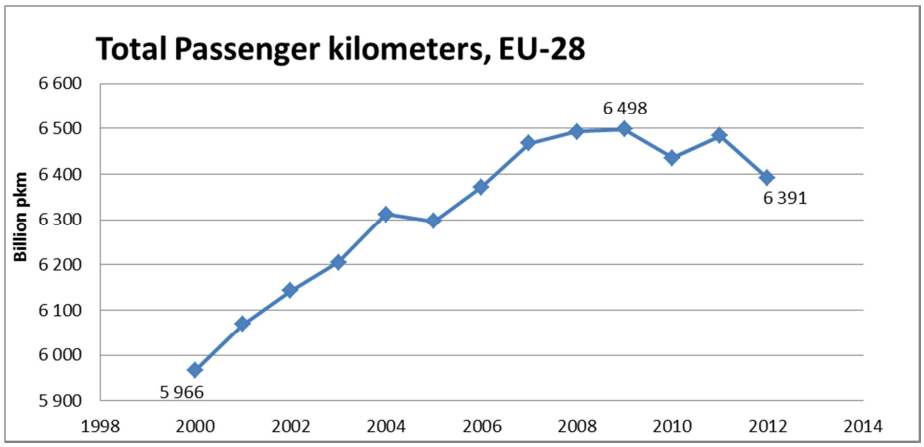
Fig. 134 Passenger and freight transport, Data: Odyssee.



Passenger Traffic

Passenger kilometres (pkm) rose from 5966 to 6498 billion pkm in 2008. In 2010 there was a drop, next year passenger-km rose again, but in 2012 there was even a larger decline than that of 2010. In total there has been 7.1% growth in the period of 2000-2012. The highest point of the period 2000-2012 was that of 2009.

Fig. 135 Passenger kilometres-All means of transport EU-28 Data: Eurostat



Passenger kilometres can be calculated separately for different modes of road transport. The modes with the largest growth are tram and metro where there has been an increase of 20% of pkm. For rail there has been growth of 12%, for passenger cars growth was 6% and for coaches and busses there has been a decline of -4% in pkm

Fig. 136 Pkm in Passenger Cars. Data: Odyssee

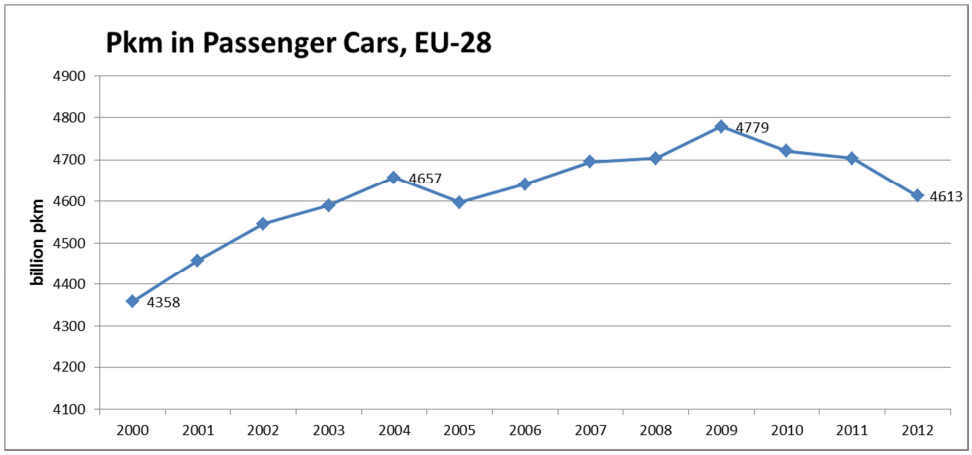


Fig. 137 Pkm in other road vehicles-excluding cars. Data: Odyssee.

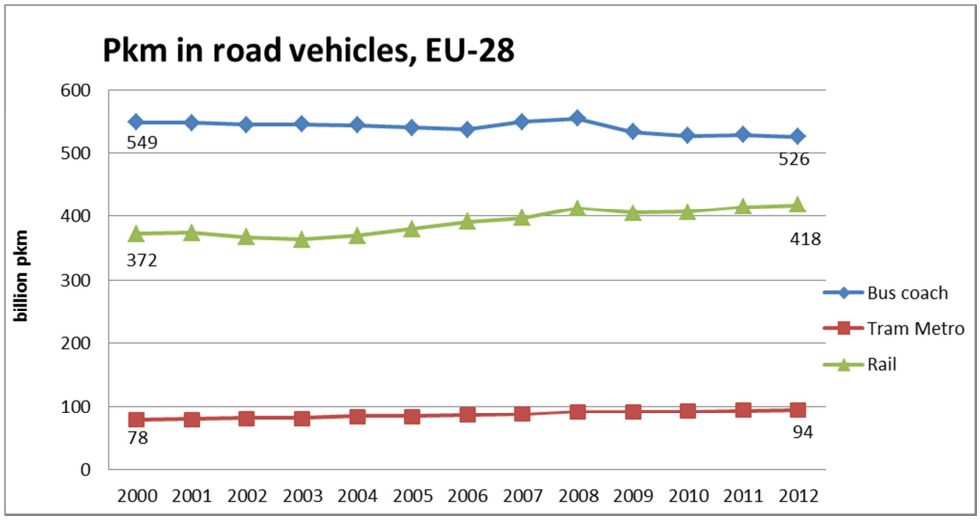
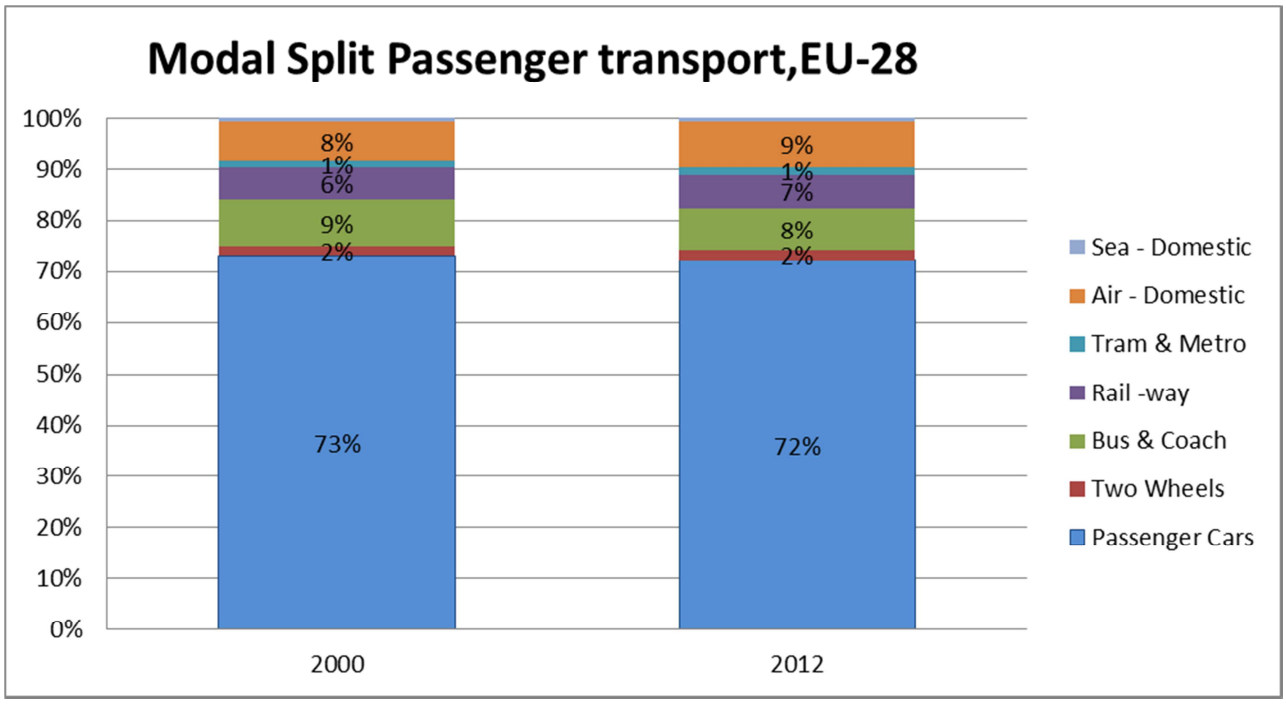


Fig. 138 Passenger transport pkm, Modal Split, Data: Eurostat



Due to the changes in pkm in total, the importance of each mode to the total pkm has changed as well. Although pkm in cars rose from 4358 to 4613 billion pkm (Table 21) the share of cars in pkm over the total dropped by -0.9% (Fig. 138). The share of bus and coach dropped accordingly by 1%, while passenger air transport became more important by increasing its share by 1.3%. Tram, metro and two wheels vehicles all slightly increased their share to the total. This shows that there is a slight shift away from using the car, busses and coaches. However this gap is mainly covered by air transport and to a lesser degree by railway, tram, metro and two-wheel vehicles.

Table 21 Pkm per vehicle, Data: Odyssee

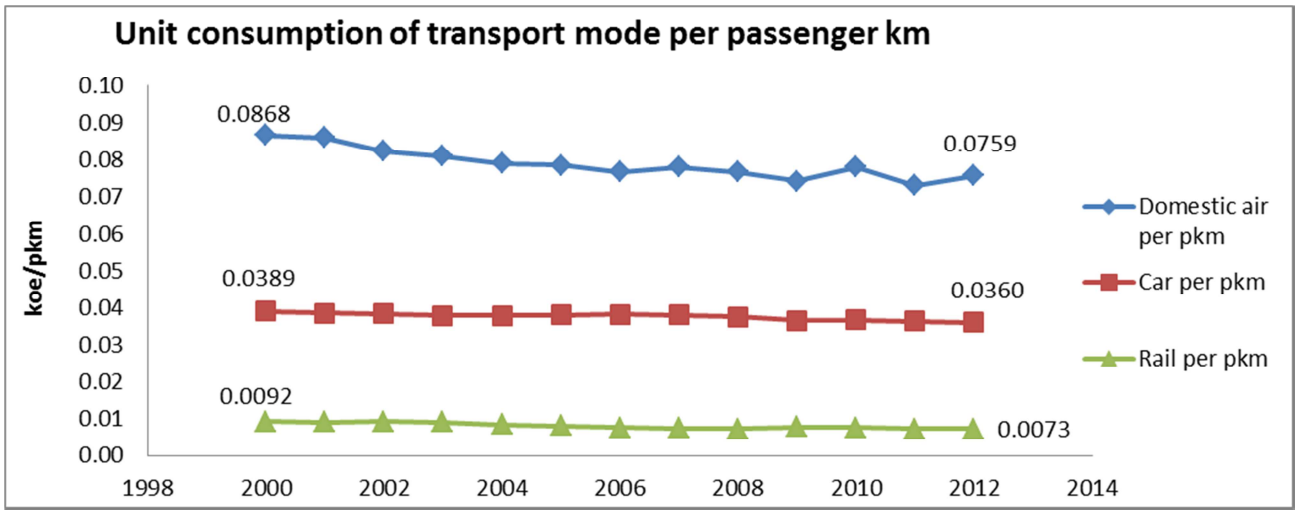
		Passenger Cars	Two Wheels	Bus & Coach	Rail -way	Tram & Metro	Air	Sea
billion pkm	2000	*4358*	*108*	*549*	*372*	*78*	*460*	*42*
	2012	*4613*	*126*	*526*	*418*	*94*	*577*	*38*
	% growth	*5.9%*	*16.7%*	*-4.2%*	*12.4%*	*20.5%*	*25.4%*	*-9.5%*
Modal Split	2000	*73%*	*2%*	*9%*	*6%*	*1%*	*8%*	*1%*
	2012	*72%*	*2%*	*8%*	*7%*	*1%*	*9%*	*1%*
	change 2012-2000	*-0.90%*	*0.20%*	*-1.00%*	*0.30%*	*0.20%*	*1.30%*	*-0.10%*

The most energy consuming mode of transport per pkm is domestic air (

Fig. 139). However there has been a decline of the consumed energy per pkm of air transport by 12.5% from 2000-2012. Car consumes less than half the energy per pkm compared to domestic air transport. The decline of the car consumption per pkm is -7.5% from 2000-2012. Rail consumes around 10% of the energy per pkm compared to air transport. Rail consumption per pkm has also declined in the period 2000-2012, by 20%. Therefore when taking into account the total pkm, rail has

had the most reduction in the energy consumption, followed by domestic air transport and last by car.

Fig. 139 Energy consumption per pkm for car, rail, domestic air, Data: Odyssee



Freight traffic

Freight traffic is measured in tonne kilometres (tkm). In 2000 it was 3513 billion-tkm and it kept increasing until 2007 when it reached 4199 billion-tkm, an increase of 20%. After 2007 it started to decline (Fig. 140). In 2009 there was a sudden decline that could be related to the financial and economic crisis. In contrast, passenger traffic reached a peak on 2009. By 2012 freight traffic reached 3768 billion tkm, this is a decline of -10% compared to 2008, but a growth of +7.3% compared to 2000 levels.

Fig. 140 Total freight transport. Data:Eurostat

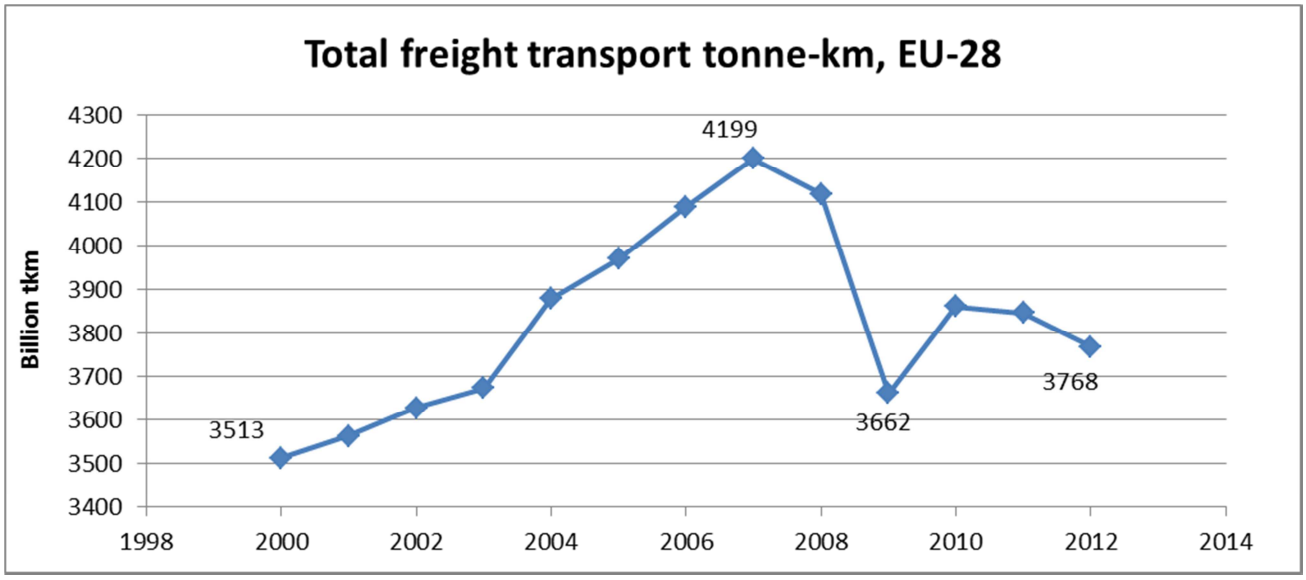


Fig. 141 Freight transport for different modes of transport. Data: Eurostat[22]

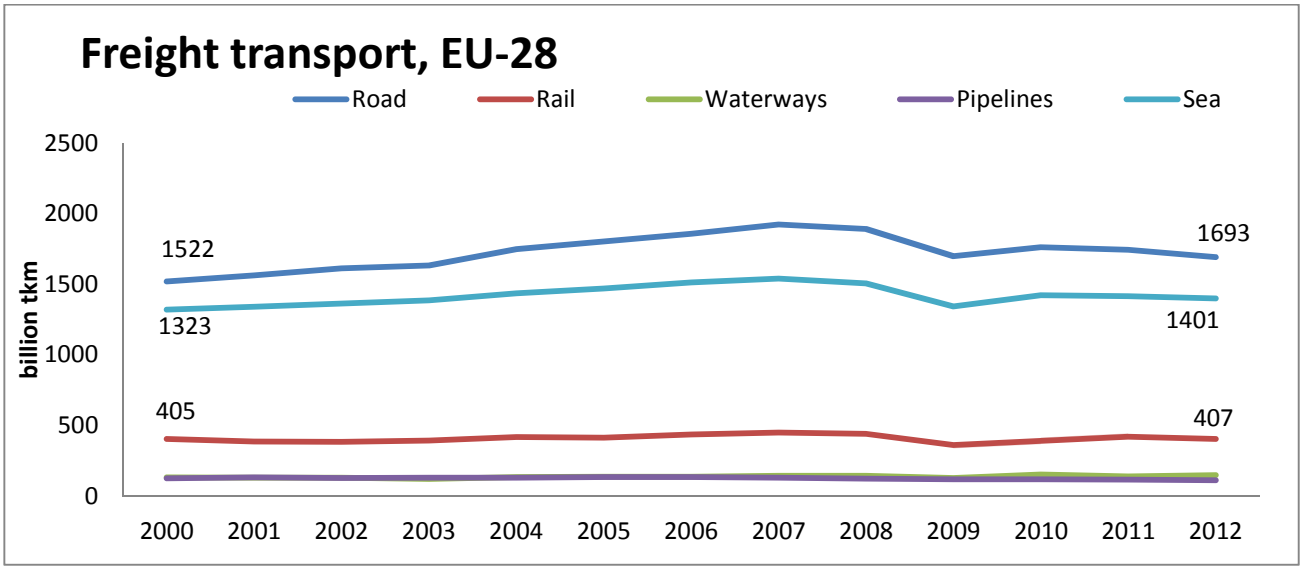
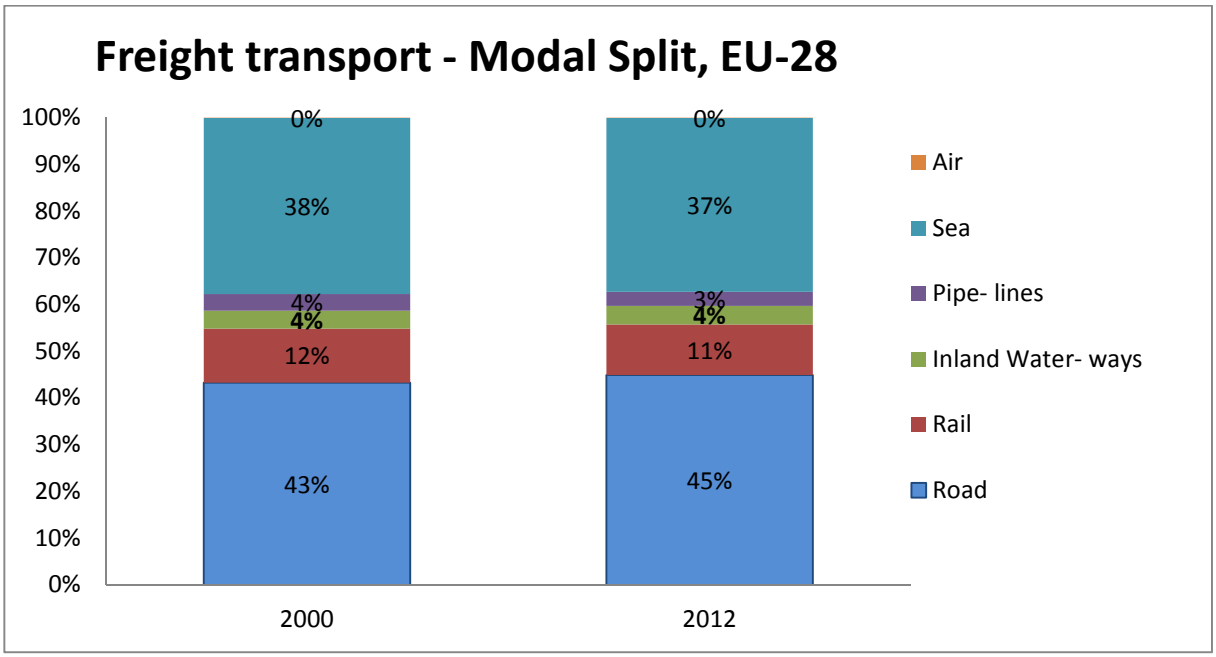


Fig. 142 Freight transport, modal split. Data: Eurostat[22]



The majority of goods in 2012 were transferred through Road (45%) and Sea (37%). Road transportation has increased since 2000 by 11% while sea transport rose by 6%. The share of each

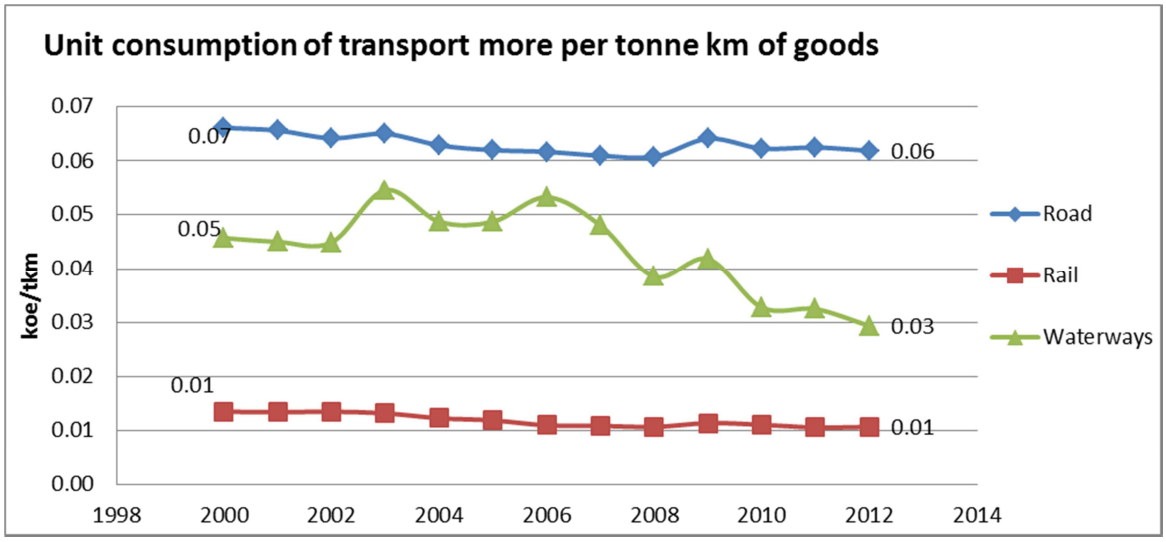
[22] Air and Sea: only domestic and intra-EU28 transport; provisional estimates.Eurostat

transport mode to the total has not changed significantly from 2000 till 2012 (Fig. 142) but the trends show a reduction of the relative importance of rail and sea transportation (Table 22).

Table 22 Tkm per different transport modes. Data: Eurostat.

		Road	Rail	Inland Water-ways	Pipe-lines	Sea	Air	Total
billion tkm	2000	*1522*	*405*	*134*	*127*	*1323*	*2*	*3513*
	2012	*1693*	*407*	*150*	*115*	*1401*	*3*	*3768*
	% growth	11.2%	0.4%	12.0%	-9.7%	5.9%	2.7%	7.3%
Modal Split	2000	*43.3%*	*11.5%*	*3.8%*	*3.6%*	*37.7%*	*0.1%*	
	2012	*44.9%*	*10.8%*	*4.0%*	*3.0%*	*37.2%*	*0.1%*	
	change 2012-2000	*1.61%*	*-0.74%*	*0.17%*	-0.57%	*-0.47%*	*0.00%*	

Fig. 143 Freight transport - Unit consumption – energy consumption of transport modes per tkm, Data: Odyssee



Unit consumption of transport in Fig. 143, shows the total energy spent for freight/goods transport per tonne-kilometer. Road has the highest energy consumption per tkm. Transport through waterways has less per tkm consumption, but there is much variation on a yearly basis. Rail consumed the least energy per tkm. In all cases the energy consumption per tkm has declined from 2000. The unit consumption of road transport from 2000-2012, has declined by 6%, of waterways by 21% and of rail by 36%.

Rail

Rail energy consumption has declined by 16%, from a total of 9.63 Mtoe in 2000 to 8.11 Mtoe in 2012. The subdivision into freight and passenger transport shows that although most of the energy consumption is related to freight transport this is also where there has been larger decline (by 20%). In the passenger sector, total energy consumption dropped by 10%. In terms of fuel, diesel consumption dropped from 3.53 Mtoe to 2.77 Mtoe which is a decline of 22% while electricity declined at a smaller rate from 6.1 Mtoe to 5.34 Mtoe, which is a drop of 12%. Therefore electricity is becoming more important.

In total, the main trends in the rail passenger sector are a growth in the number of pkm (Fig. 137) and a growth in the relative importance - modal spit - compared to all the other road transportation modes (Table 21). Also, there is 20% reduction of the consumed energy per pkm (

Fig. 139).

For freight transport there is a decline in the modal split of tkm (Fig. 142) and a decline in the energy consumption per tkm by 36%. Rail needs only 20% the energy that a car needs per pkm (

Fig. 139) and around 17% the energy of road transport per tkm (Fig. 143).

Fig. 144 Rail energy consumption breakdown, Data: Odyssee

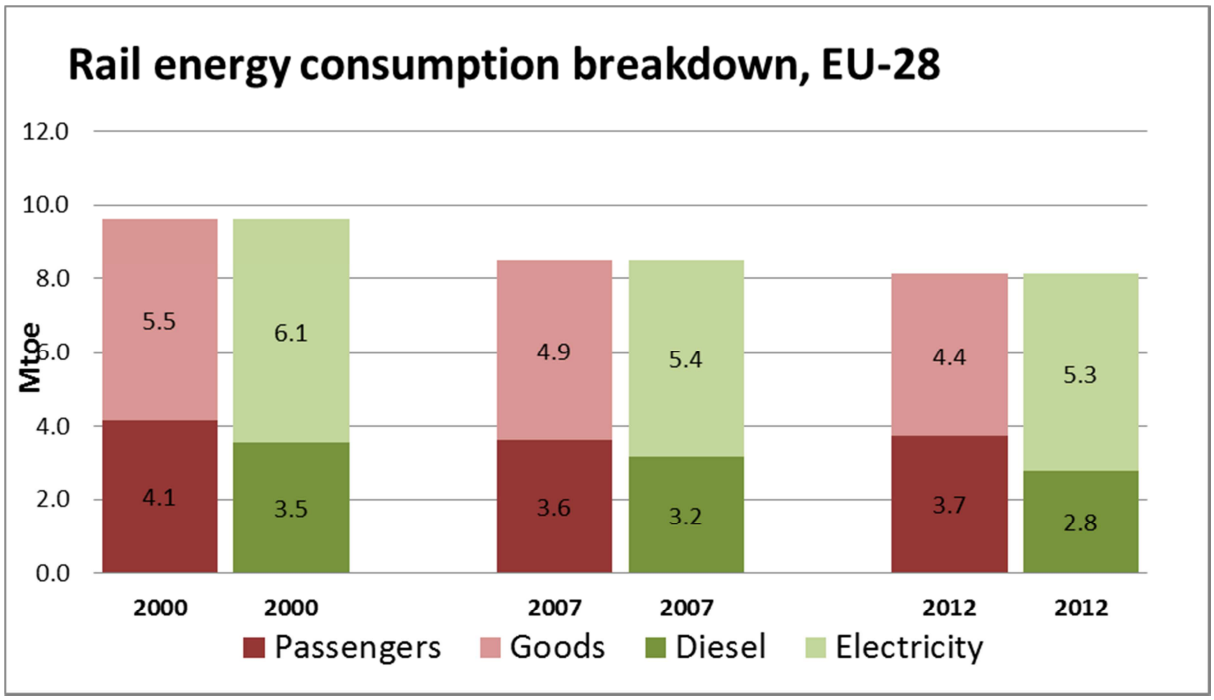
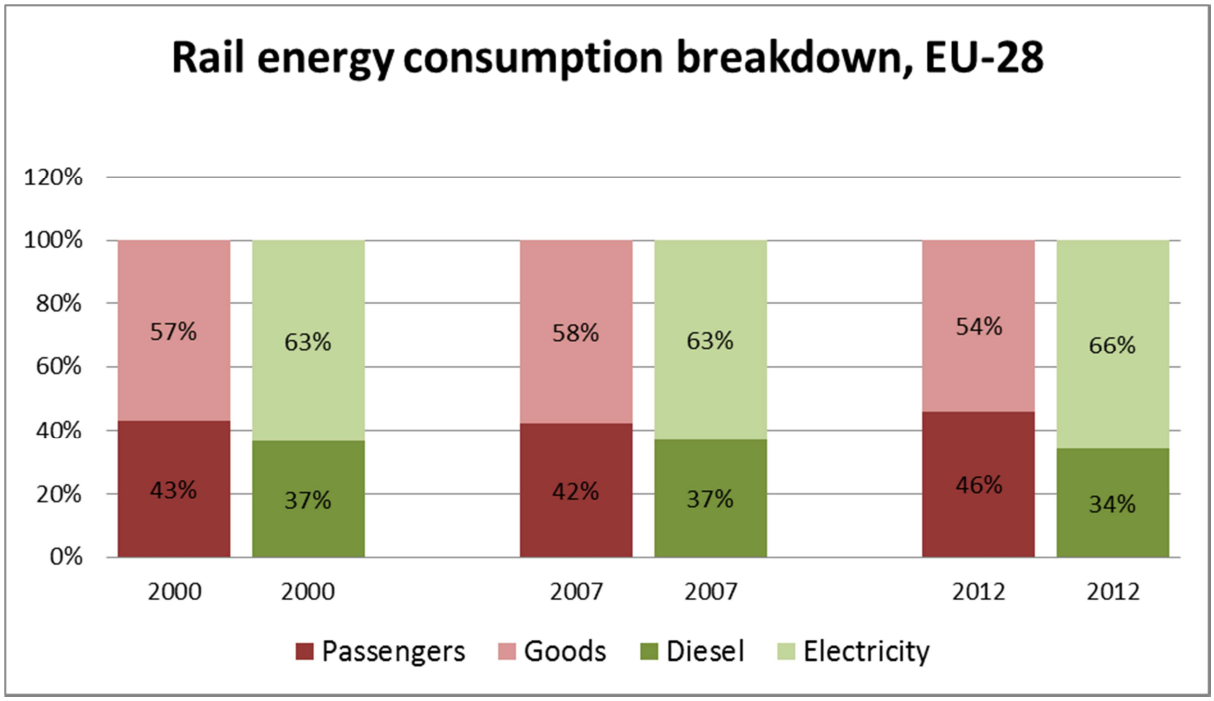
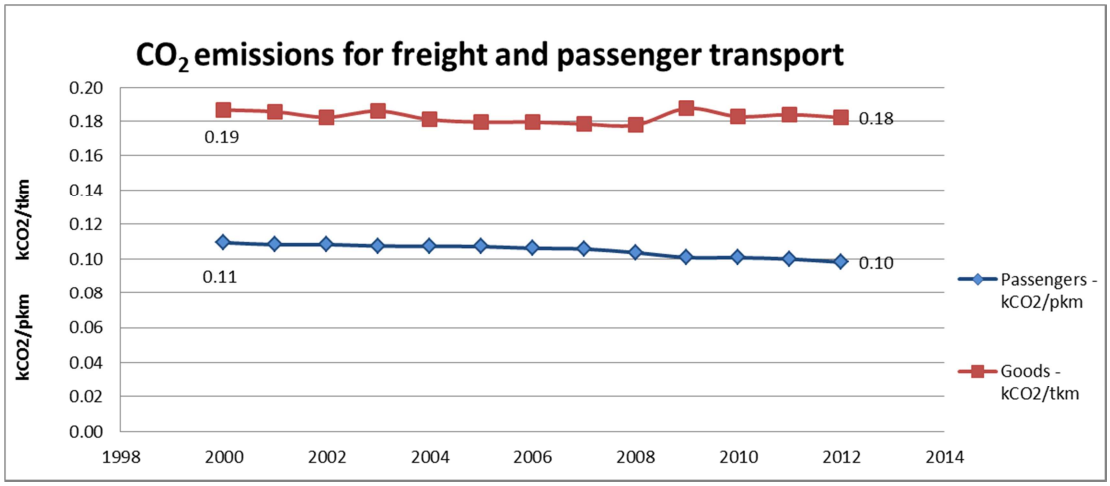


Fig. 145 Rail energy consumption modal split, Data: Odyssee



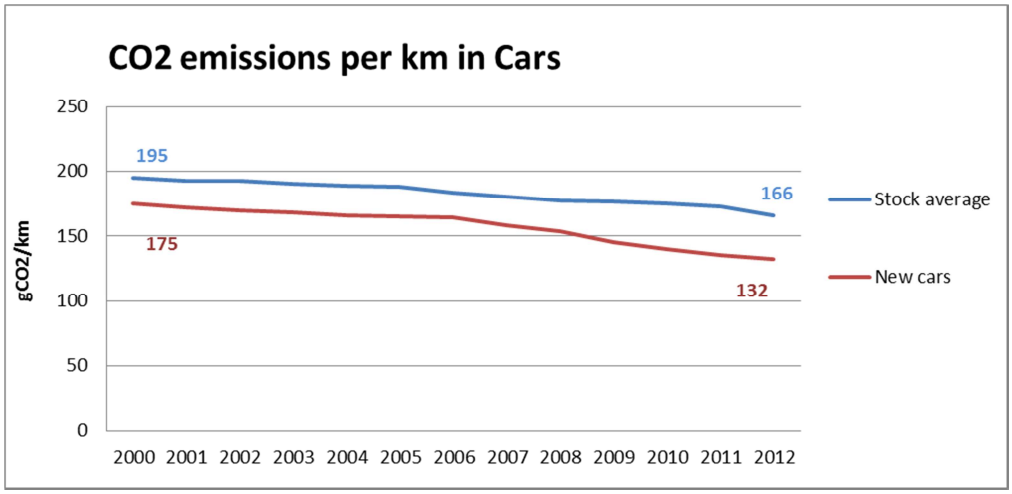
CO2

Fig. 146 CO_2. Emission for freight and passenger transport Data: Odyssee



The emissions of CO_2 for passenger transport have declined from 0.1094 kCO2/pkm to 0.0981 kCO2/pkm, this is a decline of 10.3% in 12 years. The decline has been gradual, in contrast to freight transport where there is much annual variation. From 0.1865 of kCO2/tkm in 2000, the emissions changed to 0.1821 kCO2/tkm in 2012, which is a change of -2%.

Fig. 147 CO_2 emissions per km in cars Data: Odyssee



Due to the importance of cars in the transportation system, it is important to see how their CO_2 emissions have changed. For the cars that are already in the market there has been a decline from 195 to 166 gCO2/km, which is a change of -15%. The decline of emissions of new cars is larger, from 175 gCO2/km in 2000, to 132 gCO2/km in 2012, which is a decline of -25%.

Overview – Transport sector

Transport final energy consumption in EU-28 rose by 2% from 2000-2012. Energy consumption was growing gradually with annual growth rates ranging from 1%-3% from 2000-2007, but after 2007 it started gradually to decline. The rate of change has been very steady compared to other sectors (industry or residential sector). Therefore it is possible that the reduction will continue after 2012.

The main energy sources in the transport sector is oil, which provides the 94% of total transport consumption in 2012, while biofuels and electricity provide a share of 4% and 2% respectively. The share of biofuels over the total energy supply has increased by 4% since 2000, at the expense of oil consumption. In oil the main energy sources are diesel and gasoline. Diesel is slightly substituting part of the gasoline oil.

The road sector consumes a large share, 82% of the total transport energy consumption and it has increased from 2000. The main fuel is oil (by 95%). The vehicles with the most energy consumption in road transport are cars, consuming 59% of road energy and trucks-light vehicles consuming 37%. Besides this large share of cars, their total energy consumption has declined since 2000. This means that the growth in road consumption from 2000 onwards, has happened due to growth in the total consumption of other road vehicles. There are some changes that could have led to the growth of total car consumption, such as the increase of stocks of cars by 24%[23] or the increase of cars per 1000 inhabitants by 24.5%. However there are other developments as well, such as the decline by 7.4%, of the average distance covered by car. In addition the energy consumption of new cars in the market has fallen by 25%. Therefore the reduction in total car consumption can be explained at least partly, from smaller distances and less energy consumption per vehicle. When looking into passenger

[23] Changes refer to 2000-2012.

kilometres the growth for car passenger kilometres (pkm) was 6% while the growth of the total passenger kilometres was 7%. To compare with, growth of passenger kilometres for tram and metro is 20%, for air transport 25% and rail 12%. This shows that there is also a slight shift to other modes of road transport. The pkm for busses has declined by 4%. While in 2000 more pkm were covered by bus compared to air, the situation reversed by 2012. CO_2 emissions per pkm have declined by 10% since 2000. The above show that there are some improvements in the energy consumption patterns in the energy sector.

Freight traffic is responsible for the 36% of total domestic consumption and has grown by 7.3%. There was a peak on 2007 and has been on decline after. In contrast to passenger transport, freight transport has two basic modes of transport, road that covers 45% of tonne-kilometers (tkm) and sea that covers 37% of tkm. The modes with the largest growth here are: Inland waterways with 12% tkm growth, road with 11% and sea with 6% growth. Inland waterways traffic in tkm has increased significantly besides the small share in the total freight traffic. Inland waterways consume almost half the energy per tkm compared to road transport and in addition there is a trend that shows that this consumption is decreasing at a higher rate per year compared to that of car transport consumption. CO_2 emissions per tkm have declined by 2% since 2000, which is much less than the passenger transport, were emissions declined by 10%.

5. Industry Sector

The industrial sector includes the construction, mining and manufacturing industries. Although the GVA added in the sector has increased from 2000 onwards, the share of GVA compared to the tertiary sector has declined (Fig. 95). Energy consumption in the industry sector changed from 332 Mtoe in 2000 to 283 Mtoe in 2012, which is a total change of -14.9% (Table 23). Industrial energy consumption declined in EU-15 by -13.8% and in NMS-13 by -20.6%. The general trend after 2000, shows that the industrial energy consumption was gradually declining (Fig. 149). Only in 2003 and 2007 the consumption rose compared to the previous year. In 2009 there was a large drop of -18.8% compared to the previous year, probably related to the Eurozone crisis. The following year in 2010, there was an increase of 7.7% which partially covered the large decline of 2009. However the energy consumption continued to decline. In total, with the exception of slight growths in the years 2003 and 2007, and the large drop of 2009, the industrial energy consumption of EU-28, has been gradually on decline for the period 2000-2012

Fig. 148 Gross Value Added (GVA) by sector in euro EU-28.Data: Eurostat.

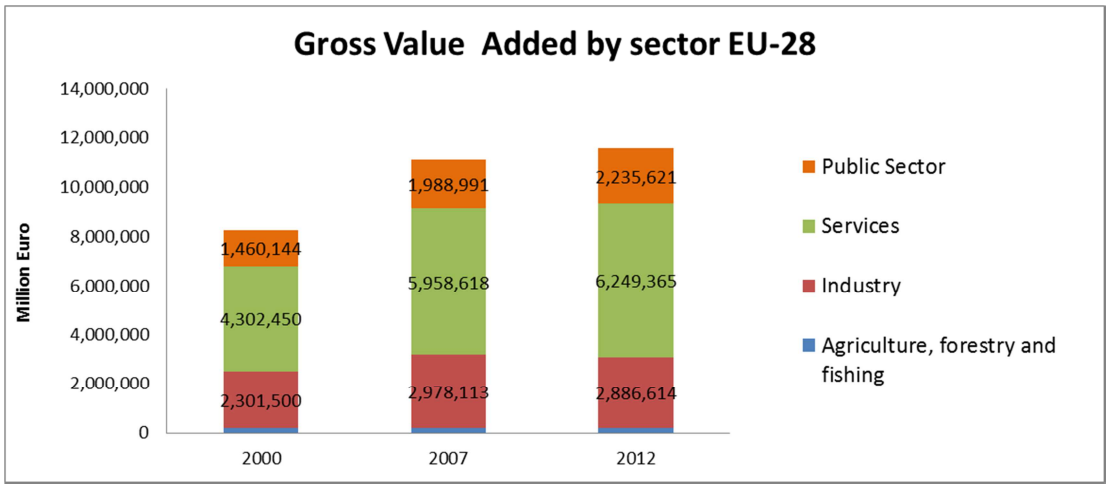


Fig. 149 Industry final energy consumption Data: Eurostat

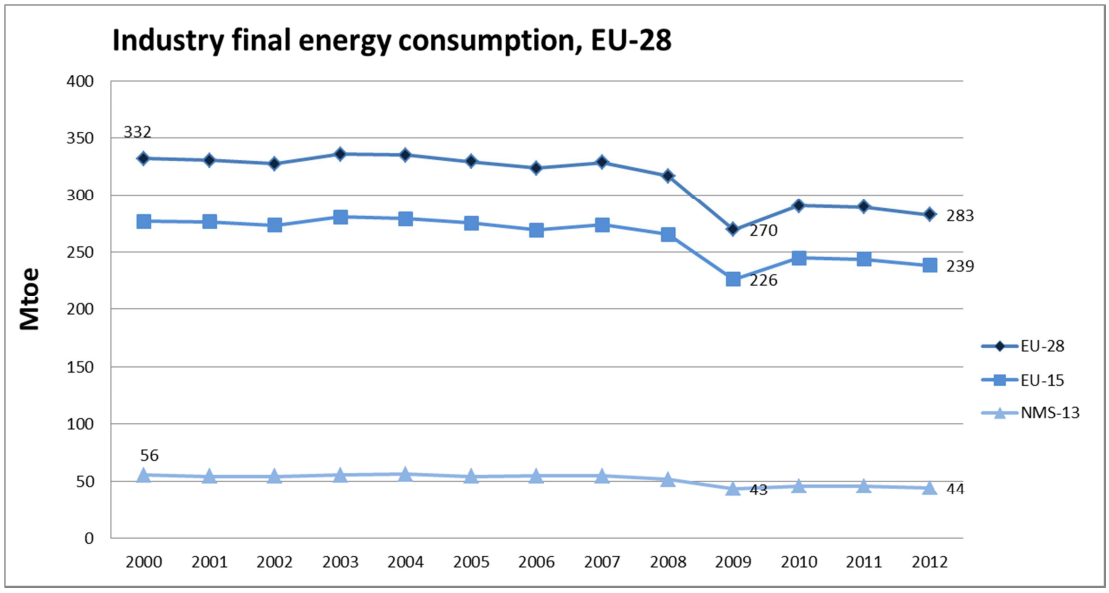


Table 23 Final Industry energy consumption – growth rates for EU-28, NMS-13, EU-15 , Data: Eurostat

	Industry energy consumption ktoe												
(ktoe)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-28	332346	330818	327773	336122	335151	329668	324024	328735	317244	269795	290678	289412	282754
EU-15	276723	276395	273507	280684	279025	275273	269329	274020	265633	226404	244920	243873	238564
NMS-13	55624	54422	54267	55438	56126	54395	54695	54714	51611	43391	45758	45538	44190
	% Change from 2000												
% EU 28		-0.5%	-1.4%	1.1%	0.8%	-0.8%	-2.5%	-1.1%	-4.5%	-18.8%	-12.5%	-12.9%	-14.9%
% EU 15		-0.1%	-1.2%	1.4%	0.8%	-0.5%	-2.7%	-1.0%	-4.0%	-18.2%	-11.5%	-11.9%	-13.8%
% NMS 13*		-2.2%	-2.4%	-0.3%	0.9%	-2.2%	-1.7%	-1.6%	-7.2%	-22.0%	-17.7%	-18.1%	-20.6%
	% Annual Change												
% EU 28		-0.5%	-0.9%	2.5%	-0.3%	-1.6%	-1.7%	1.5%	-3.5%	-15.0%	7.7%	-0.4%	-2.3%
% EU 15		-0.1%	-1.0%	2.6%	-0.6%	-1.3%	-2.2%	1.7%	-3.1%	-14.8%	8.2%	-0.4%	-2.2%
% NMS 13*		-2.2%	-0.3%	2.2%	1.2%	-3.1%	0.6%	0.0%	-5.7%	-15.9%	5.5%	-0.5%	-3.0%

Energy sources

Gas and electricity are the main energy sources of the industrial sector and they provide 32% and 31% respectively, of the total industrial energy consumption (

Fig. 150). Compared to 2000 the share of electricity to the total energy sources, rose by 3.3% while the share of gas declined by 2.3%. Other fuels whose share has increased are derived heat (+2.5%), renewable energies (+1.9 %) and waste (+1.3%). The fuels which have become less important are total petroleum products, whose contribution to the total declined by 4.4%, while solid fuels declined by 2.2%. Besides the small changes in the shares to the total consumption, some of the actual changes measured in Mtoe are significant. Waste consumption rose from 1 Mtoe to 4.4 Mtoe, which is a growth of 340% (Fig. 151). Derived heat grew by 57% and renewables energies by 18%. On the other hand, petroleum products declined by 39%, solid fuels by 27%. While the share of electricity over the total grew by 3.2% the actual consumption in Mtoe dropped by 5%. Last, gas consumption dropped by -21%.

Fig. 150 Final energy consumption in share of energy types. Data: Eurostat

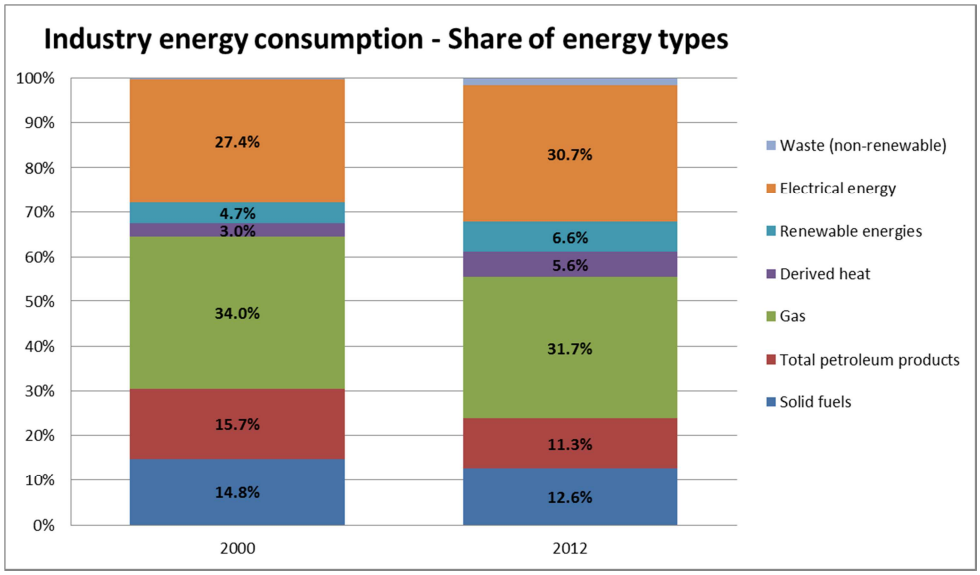
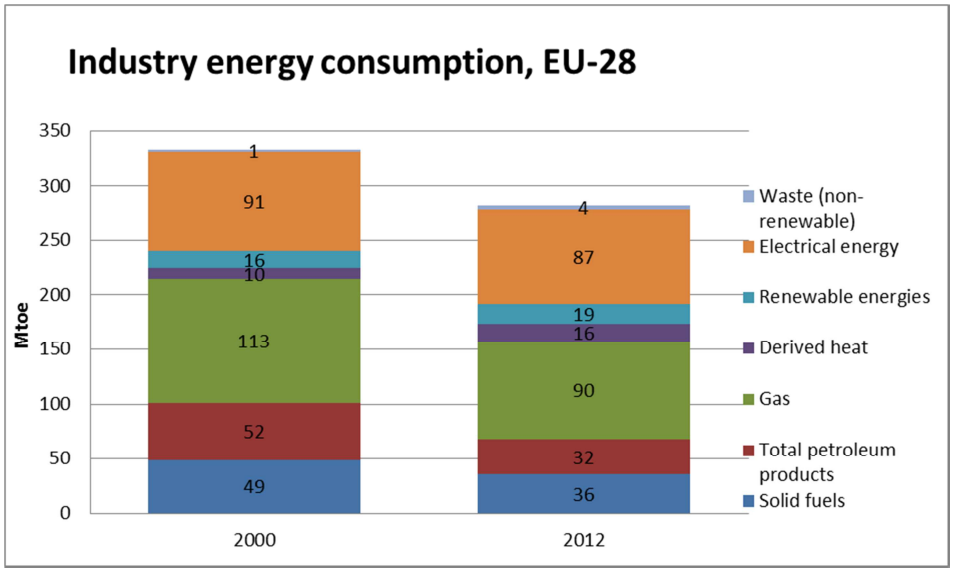


Fig. 151 Final energy consumption in the Industry sector, EU-28 Data: Eurostat



Industry Sub-sectors

The construction and mining sub-sectors consume a small amount of energy while the manufacturing sub-sector is by far the largest energy consumer. Manufacturing industry includes the chemical industry, primary metals (steel and non-ferrous metals), non-metallic minerals (cement and glass industry), wood, paper-pulp-printing, food, textile-leather, machinery, transport equipment, rubber and plastics. Fig. 153 shows the shares of each sub-sector in terms of total industrial energy consumption.

Fig. 152 Industry energy consumption by sub-sectors Data: Odyssee

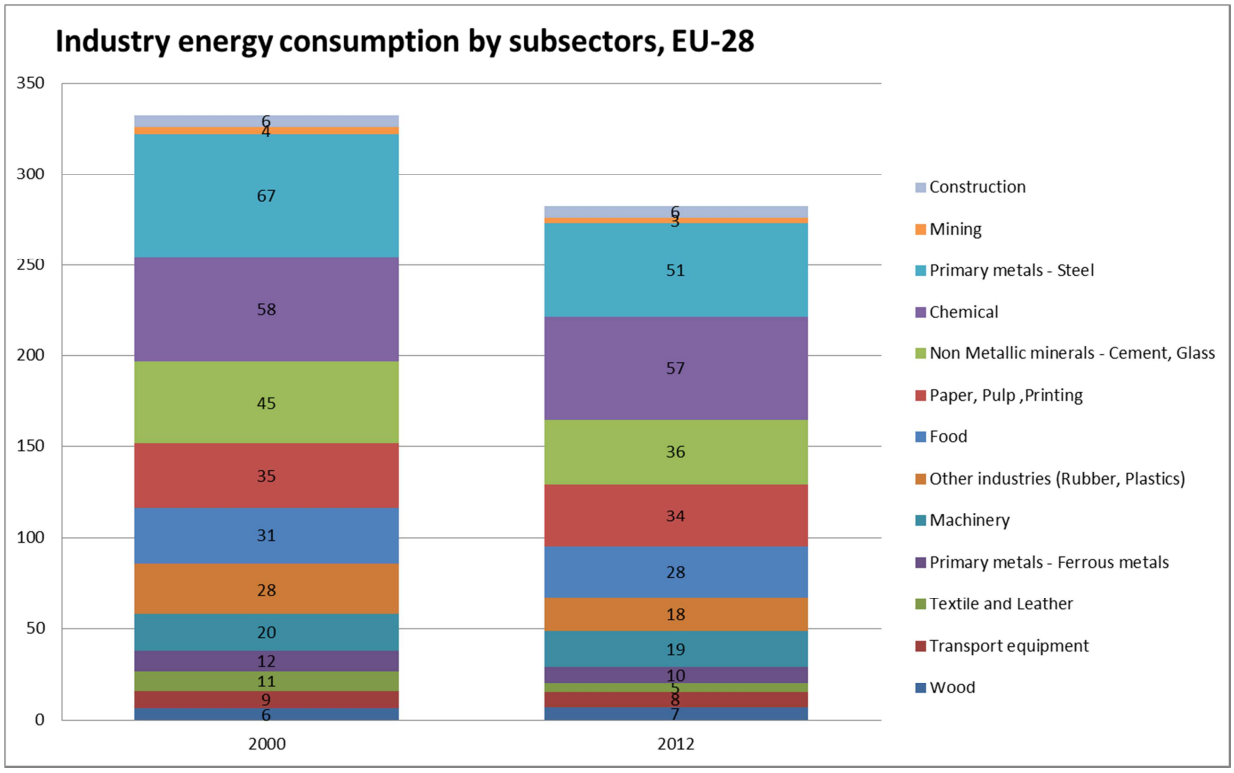
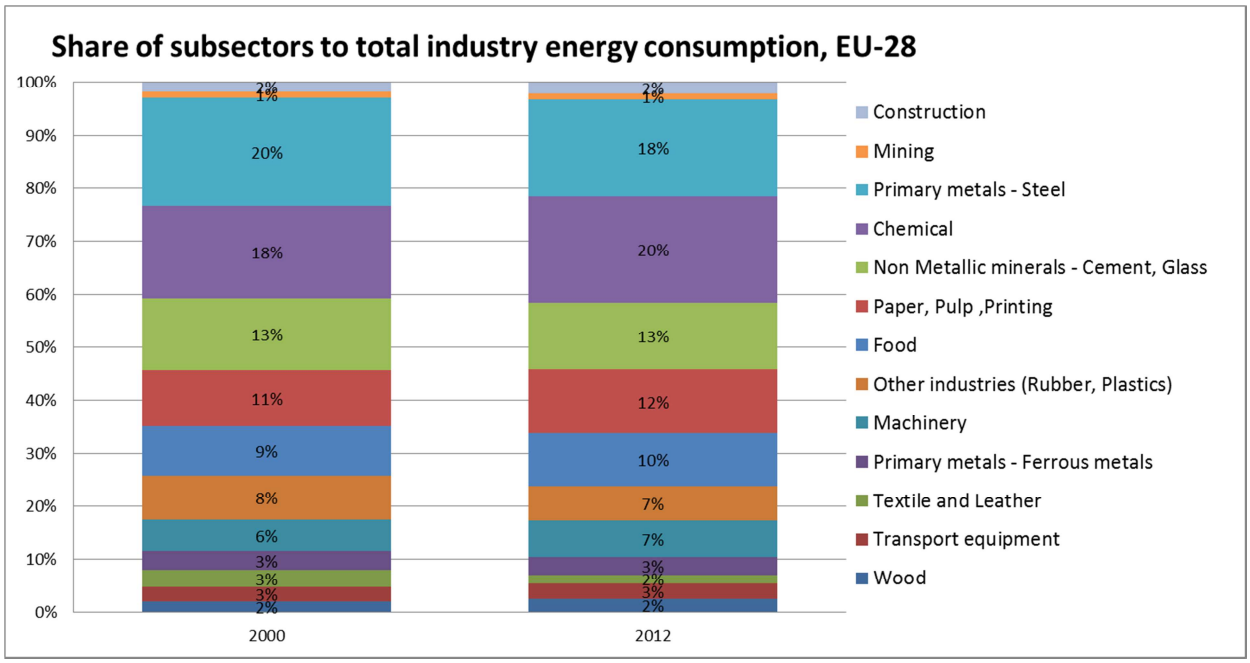


Fig. 153 Industry energy consumption by sub-sectors Data: Odyssee



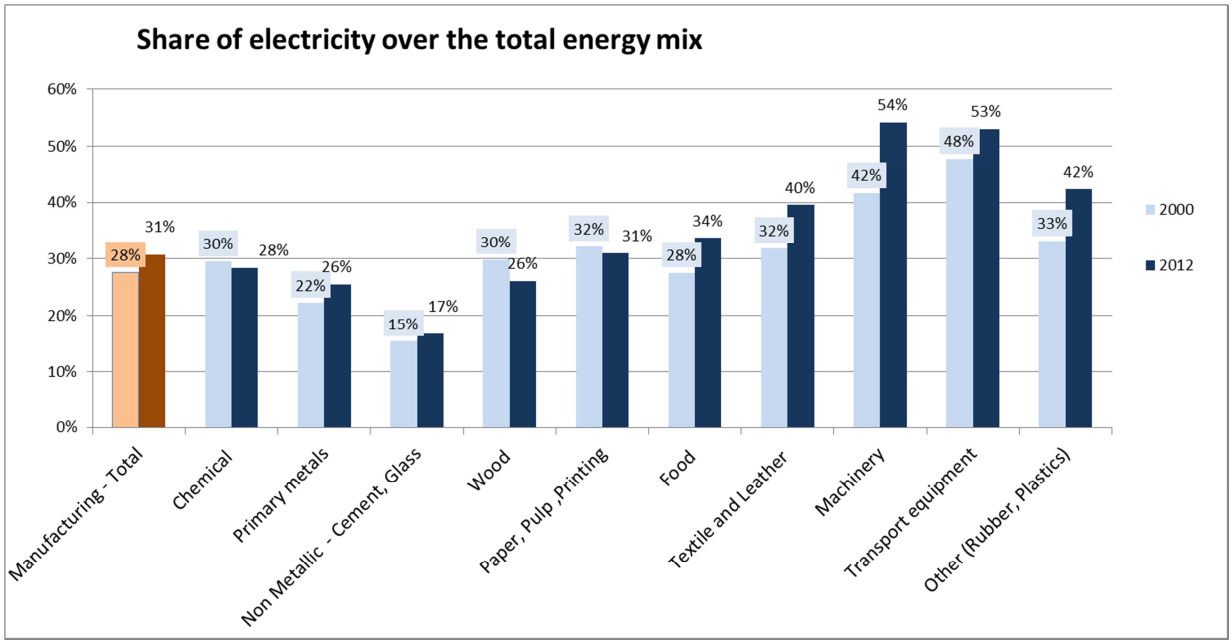
In the manufacturing industry the sectors with the most energy consumption are the steel and chemical industry which consumed 18% and 20% of the industrial energy consumption in 2012 respectively. In the chemical industry, consumption (in Mtoe), dropped by 2.9% from 2000 to 2012, while the share of the industry to the total rose by 2.5%. Similarly, consumption in the steel industry dropped by 23.5%, while the share to the total declined by 2%. Other industries where the share

grew from 2000 to 2012 are machinery (+0.9%), food (+0.6%), paper-pulp-printing (+1.5%), wood (+0.5%) and construction (+0.4%)

Table 24 Growth shares of energy consumption Industry subsectors. Data: Odyssee

	Mtoe 2000	Mtoe 2012	Change in Mtoe 2000-2012	share in % 2000	share in % 2012	Change of shares 2000-2012
Manufacturing	322	273	-15,2%	96,9%	96,6%	-0,3%
Wood	6	7	8,9%	1,9%	2,5%	0,5%
Transport equipment	9	8	-11,9%	2,9%	3,0%	0,1%
Textile and Leather	11	5	-56,8%	3,3%	1,7%	-1,6%
Primary metals - Ferrous metals	12	10	-17,8%	3,5%	3,4%	-0,1%
Machinery	20	19	-1,6%	5,9%	6,8%	0,9%
Other industries (Rubber, Plastics)	28	18	-34,0%	8,4%	6,5%	-1,9%
Food	31	28	-9,3%	9,3%	9,9%	0,6%
Paper, Pulp ,Printing	35	34	-3,2%	10,6%	12,1%	1,5%
Non Metallic minerals - Cement, Glass	45	36	-19,8%	13,4%	12,6%	-0,8%
Chemical	58	57	-2,9%	17,5%	20,0%	2,5%
Primary metals - Steel	67	51	-23,5%	20,3%	18,2%	-2,0%
Mining	4	3	-21,4%	1,2%	1,1%	-0,1%
Contrustion	6	6	1,5%	1,9%	2,2%	0,4%
Industry Total	332	283	-14,9%	100,0%	100,0%	

Fig. 154 Share of electricity consumption over the total energy consumption for each subsector. Data: Odyssee



In the manufacturing industries, the share of electricity over the total energy sources rose from 28% to 31%. A large part of this growth took place in the sectors of food, textile-leather, machinery, rubber and plastics. In some sectors, such as the chemical industry and wood, electricity consumption declined over the total sectorial energy consumption compared to 2000 (Fig. 154). In contrast, the share of gas over the total energy consumption in the manufacturing industry declined from 35% to 32% in 2012. When looking into the manufacturing subsectors, gas declined in most of the sectors with the exception of wood and food (

Fig. 155).

Fig. 155 Share of gas over the total energy consumption for each subsector. Data: Odyssee

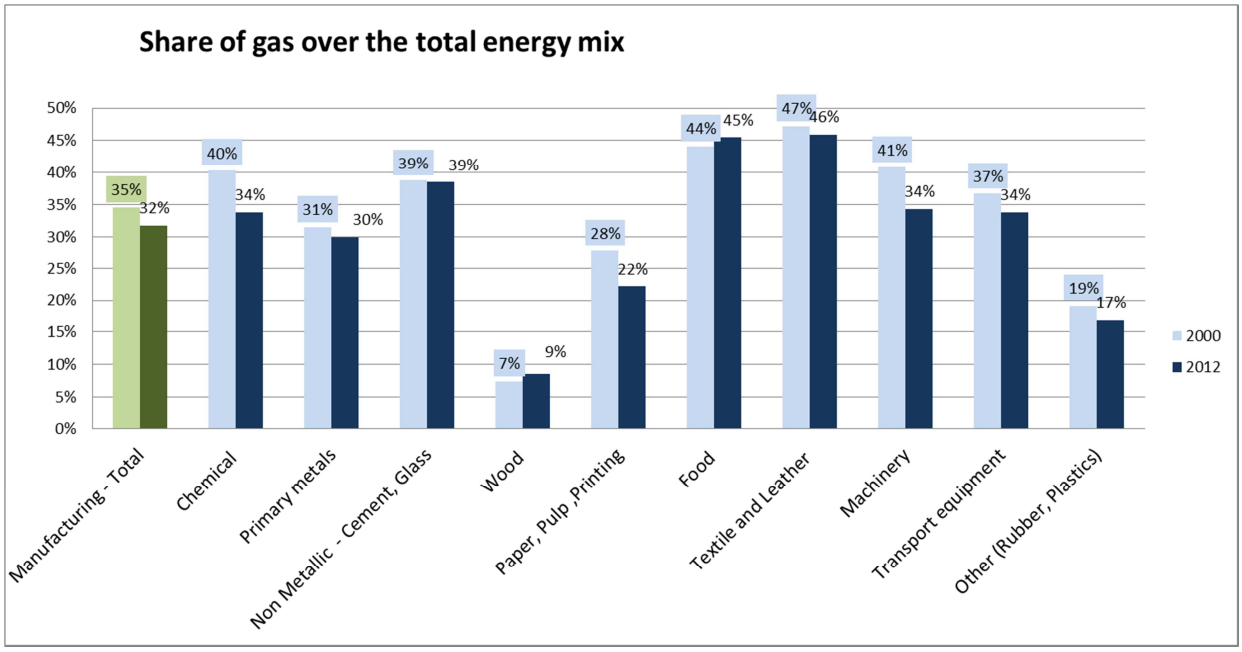
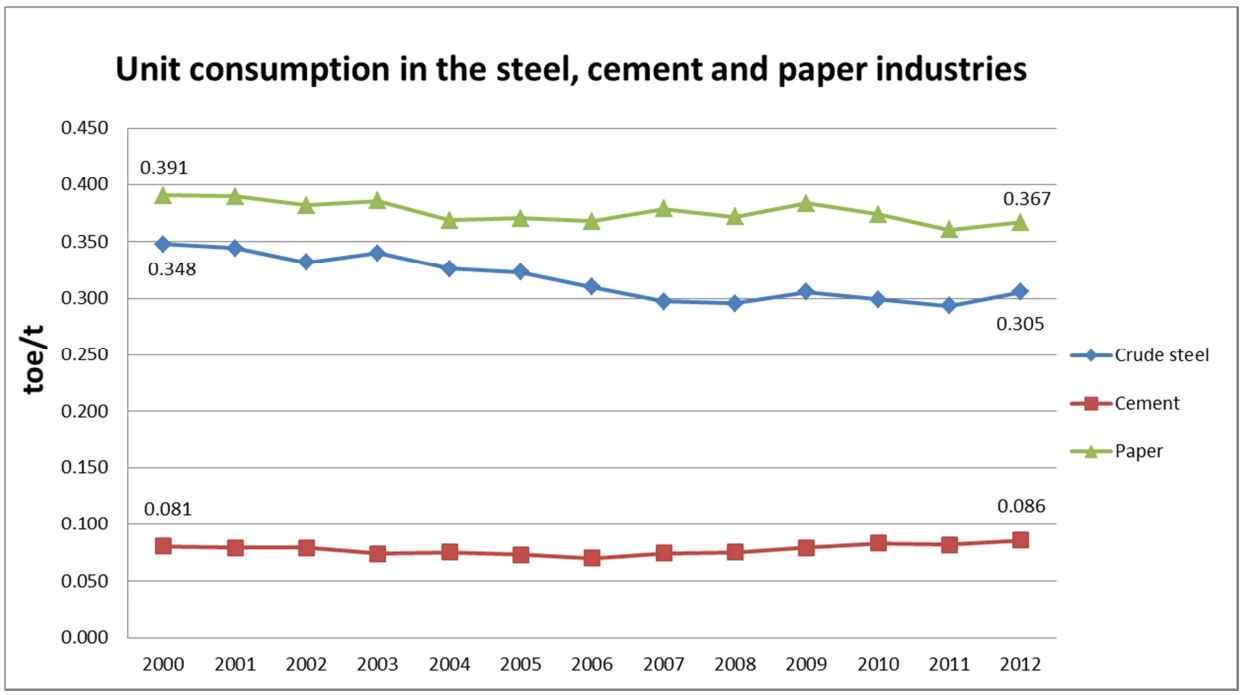


Fig. 156 Unit consumption –Energy consumption per tonne of produced crude steel, cement and paper.Data Odyssee



In order to evaluate better the changes in energy consumption, it is important to have information about the output of industrial processes. Fig. 156 shows how the energy consumption per produced tonne has changed in time. For steel which consumes 18% of the total industrial energy consumption, there has been a 12% reduction of energy consumption per tonne. In 2000 there was 0.391 toe of energy consumption for each tonne of steel and this dropped to 0.367 toe/t in 2012. Similarly, the unit consumption of paper production has declined by 6%, while the unit consumption of cement production rose by 6%. Therefore the energy consumption per tonne of output, declined

for the most energy consuming sectors (per tonne of output) of paper and steel, while it rose for the less energy consuming per tonne sector of cement.

The industrial production index shows the output and activity of the industry sector. It measures changes in the volume of output on a monthly basis. Fig. 157 shows the industrial production index with a base year of 2005. There has been a decline in mining and less decline in construction. Manufacturing industries experienced a decline on 2009, probably related to the economic crisis and recovered afterwards. In 2012 production output declined again. By comparing with the value added per Industry Fig. 158, it can be seen that the value added per sector did not decline as happened with the production index.

Fig. 157 Industrial production Index. Data: Odyssee

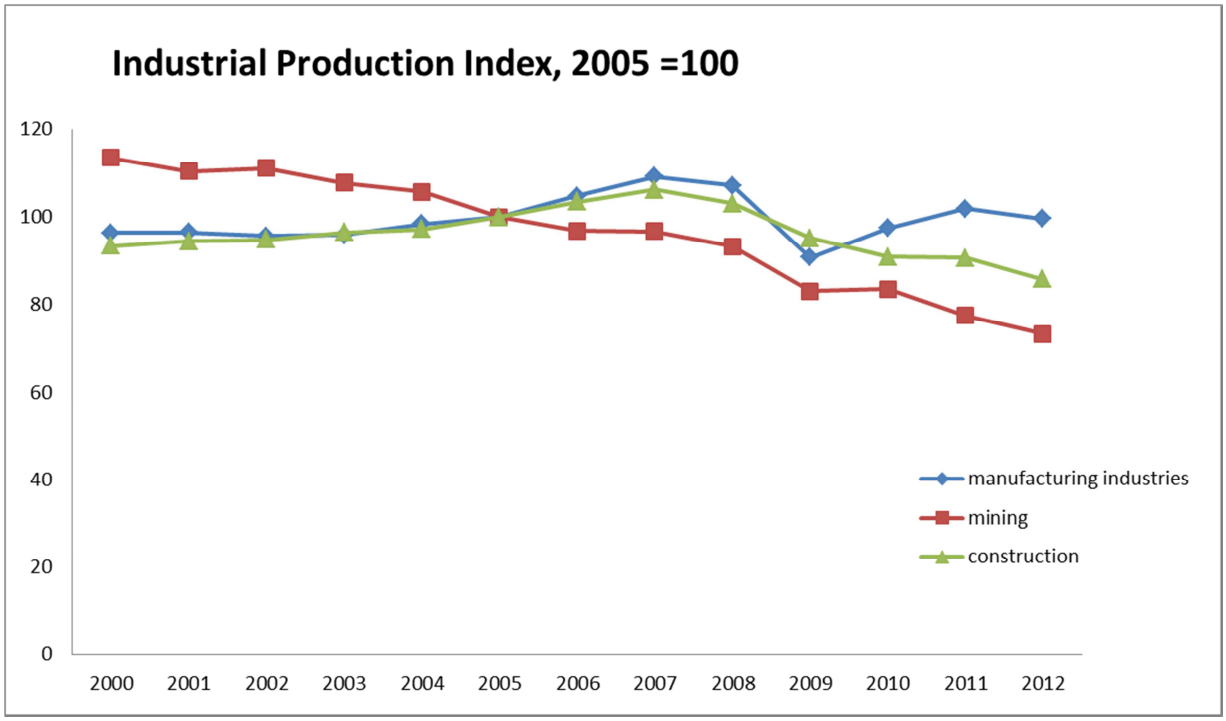


Fig. 158 Value Added per Industry sub-sector, Data:Odyssee

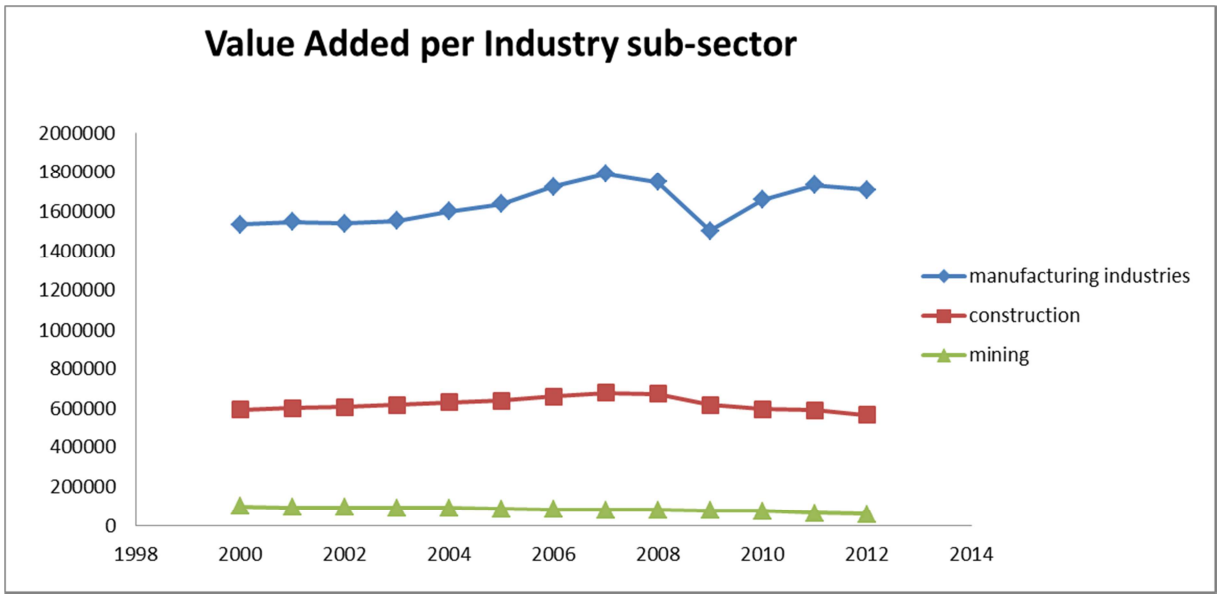


Table 25 Value added per industry sector, Industrial production Index . Data: Odyssee

	Industrial production index of industry		% of production index 2000-2012	Value added		% value added
	2000	2012		2000	2012	
Industry - All	**95.35**	**95.38**	**0.0%**	**2468274**	**2605874**	**5.6%**
manufacturing industries	**96.44**	**99.67**	**3.3%**	**1536005**	**1710503**	**11.4%**
chemical industry	86.96	107.54	23.7%	151597	171474	13.1%
primary metals	97.78	88.53	-9.5%	74230	64061	-13.7%
non metallic minerals	99.61	76.75	-23.0%	71036	68437	-3.7%
wood industry	98.14	81.92	-16.5%	35153	33327	-5.2%
paper and printing industry	97.22	91.24	-6.2%	91610	87434	-4.6%
food industry	94.52	102.56	8.5%	204581	216182	5.7%
textile and leather industry	138.94	71.97	-48.2%	84224	63745	-24.3%
machinery	97.65	101.42	3.9%	500176	610049	22.0%
transport equipment industry	92.80	105.69	13.9%	149807	198414	32.4%
other industries	95.44	102.52	7.4%	138949	153015	10.1%
mining	**113.49**	**73.34**	**-35.4%**	**99132**	**59963**	**-39.5%**
construction	**93.51**	**85.81**	**-8.2%**	**594986**	**568385**	**-4.5%**

Fig. 159 compares the growth of production index to the growth of energy consumption for the industry subsectors. In the industries of chemicals, food, machinery, transport equipment and others, although there was an increase of the production index, energy consumption declined, which can indicate improvements in energy efficiency. In the case of wood and construction, there was growth in the energy consumption, although there was decline in the production index.

Fig. 159 Growth of production index and energy consumption per sub-sector, Data Odyssee

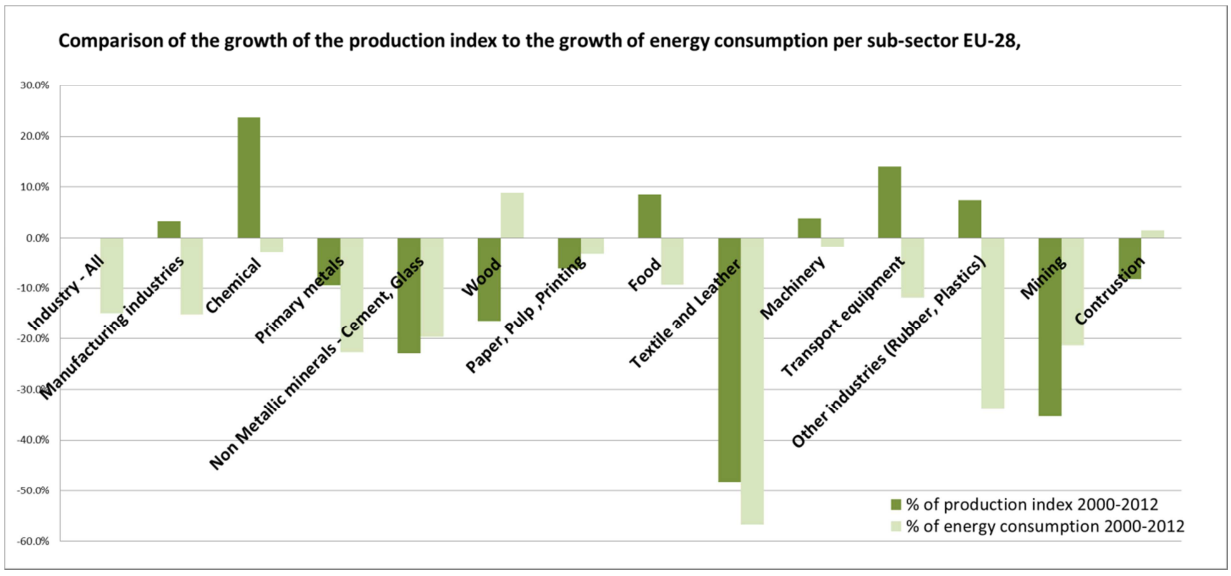


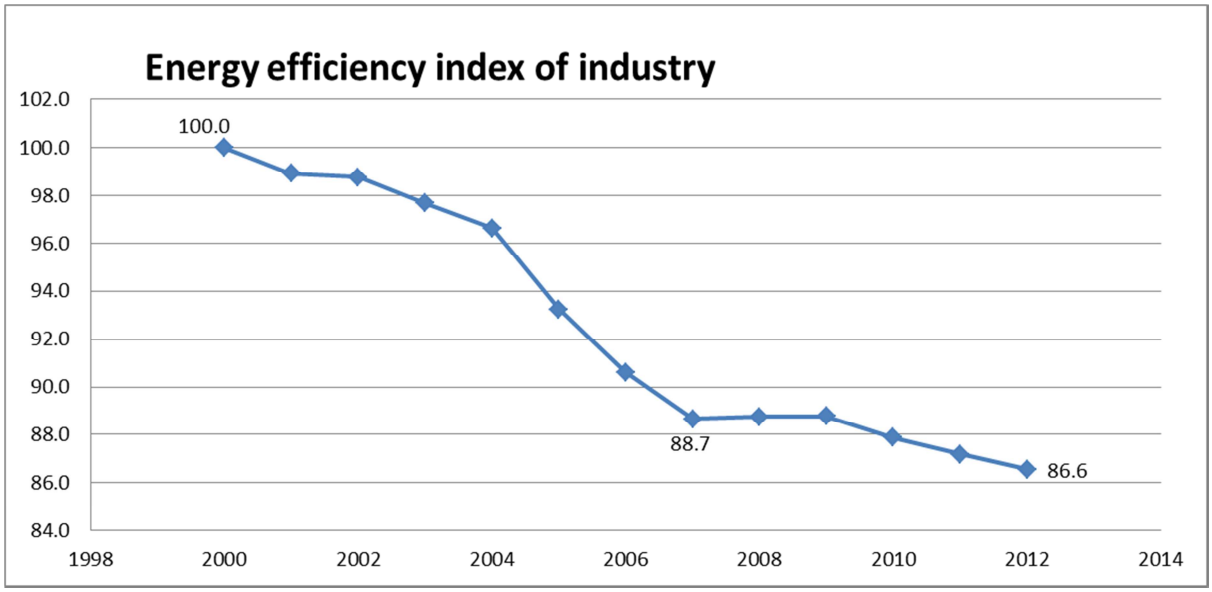
Table 26 compares the changes in value added, production index and energy consumption from 2000-2012. It can be seen here as well that in wood and construction there is decline of the production index and added value, but still growth in energy consumption. In the case of primary metals, non-metallic minerals, paper and printing, textile and leather and mining industry, there has been decline in all three aspects, which makes it difficult to evaluate whether any energy efficiency improvements have been implemented. In total for the whole of Industry, there has been approximately 6% growth in value added, almost stable production index and reduction of the energy consumption, which could suggest improvements in energy efficiency.

Table 26 Industry – Energy consumption by subsector and growth rates, Data: Odyssee

	% value added 2000-2012	% of production index 2000-2012	% of energy consumption 2000-2012
Industry - All	5.6%	0.03%	-14.9%
manufacturing industries	11.4%	3.3%	-15.2%
chemical industry	13.1%	23.7%	-2.9%
primary metals	-13.7%	-9.5%	-22.7%
non metallic minerals	-3.7%	-23.0%	-19.8%
wood industry	-5.2%	-16.5%	8.9%
paper and printing industry	-4.6%	-6.2%	-3.2%
food industry	5.7%	8.5%	-9.3%
textile and leather industry	-24.3%	-48.2%	-56.8%
machinery	22.0%	3.9%	-1.6%
transport equipment industry	32.4%	13.9%	-11.9%
other industries	10.1%	7.4%	-34.0%
mining	-39.5%	-35.4%	-21.4%
construction	-4.5%	-8.2%	1.5%

The energy efficiency index (ODEX)[24] is an index used to measure energy efficiency progress for the industry sector. According to this index there have been improvements in the energy efficiency from 2000 till 2012 (Fig. 160). Especially the period 2004-2007 there was large reduction, but also after 2007 there is still decline, although with smaller rate.

Fig. 160 Energy efficiency Index of Industry Data: Odyssee



[24] http://www.indicators.odyssee-mure.eu/odex-indicators-database-definition.pdf

The energy intensity of industry at purchasing power parities in

Fig. 161 shows also that there is decline of the energy consumption per €2005 (Mtoe/€). This decline has taken place in all the sectors with the exception of the paper industry, where there is some small growth Fig. 162

Fig. 161 Energy Intensity of Industry Data: Odyssee

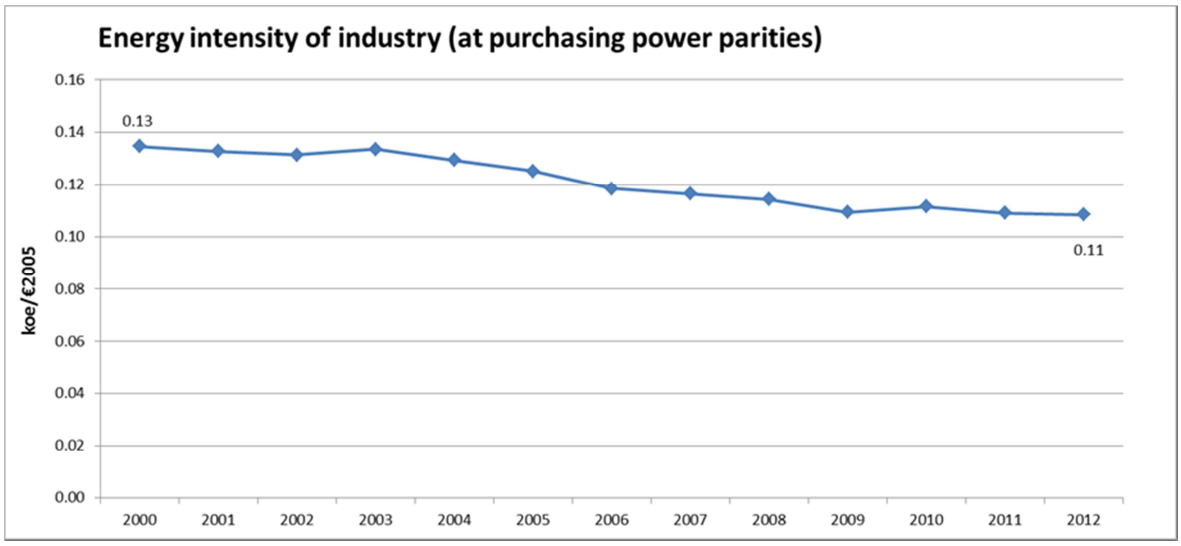
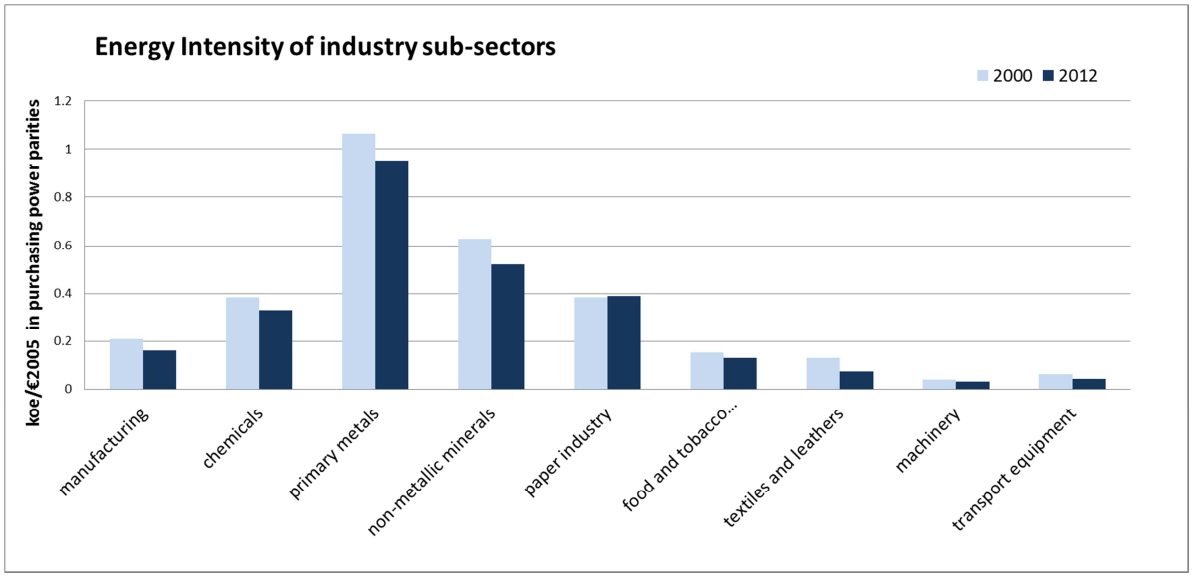


Fig. 162 Energy Intensity of Industry Sub-sectors Data: Odyssee



Overview-Industry

Final energy consumption in the industry sector fell by -15%. The energy consumption per subsector shows that the largest reductions took place in the textile leather industry (-57%) and in rubber-plastics (-34%), while in the sectors of wood and construction energy consumption grew. In terms of production output, chemical industry is the industry with the most growth in the production index, while mining, textile and leather have experienced strong decline. The added value of the manufacturing industry in total has grown but the added value of the mining and construction sectors has declined.

In 2012 electrical energy and gas provide almost the same amount of energy for the total of industrial purposes, however the trends show that electrical energy is increasing, while gas is declining.

In total, the value added in all the industry sectors has increased from 2000 by 6%, the production index remained stable while the energy consumption declined significantly. The energy efficiency index and the energy intensity of industry have both declined from 2000. Therefore there are indications that there have been improvements in the energy efficiency of the industry sector.

Conclusions

This report describes and analyses the energy consumption patterns in EU-28 for the period 2000 - 2012. Such an analysis is important, as it can give some indications about whether the policies aiming at energy efficiency improvements in EU have been effective. The sectors that are covered are the residential sector, tertiary sector, transport sector and industry.

The results show that in total final energy consumption has declined from 2000 (-2%). The breakdown into different sectors, shows that the largest decline of energy consumption took place in the industry sector (-15%), in the residential sector there was some small decline (-2%), in the transportation sector there was slight growth (+2%) and the tertiary sector grew significantly (+27%).

As many of the policies in EU aim at the residential sector, a special focus is given at this report. The residential energy consumption depends on many variables: heating degree days, population, GDP, number of dwellings and total floor area. Different combinations of these variables were used in order to assess whether the residential energy consumption has declined even after these variables were taken into account. After correcting for population and for population and heating degree days together, there was still reduction in the residential consumption. Because GDP has grown signifantly the last years, it is important to take this into account as well. Taking GDP per capita into account and then combining the effect of HDD, there is still reduction in consumption. Performing the same analysis per dwelling (and per square meter separately) and then dwelling (or sq.m.) and HDD combined, all return similar results. Last, when correcting residential consumption per capita, for HDD, GDP per capita and square meters, the results show a very gradual decline from 2000 onwards. The above results show that the reduction in the residential energy consumption cannot be explained by changes in the above mentioned variables. That is an indication that energy efficiency policies have been effective, though directly measuring this effect requires a more complex analysis than the one presented here.

In the tertiary sector there has been significant growth of the energy consumption. When comparing this growth to the GVA though, consumption per GVA from 2000-2012 declined. Energy consumption per employee slightly grew, while when correcting for the floor area for only a small sample of member states consumption declined. Electricity consumption per employee has grown, and gas consumption per employee declined.

In the transport sector there was growth of final energy consumption. When comparing the growth to the GDP growth however, there is reduction. A large part of transport is due to road transport and in specific cars. The energy consumption per car is gradually declining every year. Decline is still observed even after the changes in the annual distance per car and in the number of vehicles are being taken into account.

In the industry sector there has been large decline in the energy consumption and in specific in the manufacturing and mining sector. In the construction sector, there is slight growth. In the manufacturing sector which is responsible for the 97% of the energy consumption the production index has remained almost the same, while the energy has declined which indicates improvements in energy efficiency. In the mining sector, both production and energy consumption has declined, which gives no indication about energy efficiency changes. Last in the construction sector production has declined while energy consumption has grown, indicating deterioration of energy efficiency.

However more in depth analysis is needed in the different subsectors in order to better understand the changes in the production and how these interact with energy consumption patterns.

The above analysis shows that there are strong indications of improvements of in the energy consumption patterns through all the sectors. When comparing energy consumption with GDP or GVA, there is decline in all four sectors. This indicates that economic growth was not accompanied by the same amount of growth in energy consumption. When looking more closely to the energy consumption and by comparing it to the most important variables for each sector (population, heating degree days, number of vehicles, production output, etc.) the results show that most of the times there is reduction of energy consumption and therefore improvements in energy efficiency. These improvements can be possibly the result of the energy efficiency policies that have been implemented in EU-28. However, it is important to note that the above information refers to the general picture of EU-28. When looking into individual member states or different fuel types, there is much variety. Nevertheless, further research could quantify and better describe the degree to which the policies have affected the energy consumption patterns in individual member states and in EU-28.

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